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ADRENOCORTICAL TUMOURS

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IT is only natural that any lesion causing precocious puberty or any change in the sexual pattern will attract attention on account of the gross and varied clinical manifestations.

Bishop (1947), in his summary of the main causes of sexual aberration, excluding congenital abnormalities, mentions

(1) Adrenocortical hyperplasia or tumour,

(2) Basophil cell tumour of the anterior pituitary gland and tumour of the pineal body and hypothalamic region: in the latter two instances the endocrine disturbance is probably due to anterior pituitary stimulation, with the production of excessive gonadotrophic hormone.

(3) Interstitial cell tumour of the testis.

(4) Granulosa cell tumour of the ovary.

To this list may be added arrhenoblastoma of the ovary which has recently been well described by both Thomas (1949) and Fowler (1951).

All of these are rare conditions but probably the least uncommon is adrenocortical hyperplasia or tumour.

Endocrinology of the Adrenal Cortex

The mammalian adrenal gland consists of two distinct parts which, in most instances, are anatomically united but which are quite different structurally and entirely divorced functionally.

This is understandable when one realizes that, while the medulla of the adrenal gland develops from an ectodermal anlage, the cortex arises as a bud from the mesoderm of the coelomic epithelium and in man eventually forms nine-tenths of the total gland.

The association of disordered genital development with adrenal disease was described by Cook as far back as 1756 (Aird, 1949), but no further light was shed on the subject for the next century.

Addison, in 1855, was the first investigator to throw some light on the hormonal activity of the adrenal glands. In the last twenty-five years, however, our knowledge of the active principles of the adrenal cortex has increased to such an extent that it is now possible to relate in some degree the bizarre manifestations of adrenocortical tumours in man to over-activity of certain of the specific hormones of the cortex.

More than twenty years ago numbers of observers had already shown that complete adrenalectomy in animals was invariably fatal.

In 1931 Swingle used lipoid solvents to extract a potent substance from the cortex, the administration of which kept adrenalectomized animals alive indefinitely.

Reichstein and his associates isolated the specific corticoid hormone, cortisone, in 1937, and since then many more active principles have been identified.

Altogether, more than 28 crystalline compounds, all steroids, have now been isolated from the adrenal cortex (Hawker, 1950).

The active principles may be divided into four distinct groups, the androgenic hormones, the corticoid hormones, the oestrogenic hormones and the progestational hormone.

As will be seen later, it is the androgenic and the corticoid hormones which play the most important parts in the clinical pictures in cases of tumour.

A further word about the corticoid hormones is necessary. Four of them, Corticosterone (Compound B), 11-dehydrocorticosterone (Compound A), 17-hydroxycorticosterone (Compound F), and 17-hydroxy-11-dehydrocorticosterone (Compound E), commonly known as Cortisone or Cortone, all have a very similar chemical constitution and as a group influence carbohydrate, protein and fat metabolism, Compound B having a particularly potent effect on carbohydrate metabolism.

It is thought, also, that Compound A and Compound B exert a special influence on fat metabolism (Walters, 1952).

A fifth corticoid hormone, Desoxycorticosterone—known in the form of the acetate as DOCA—which differs from Cortisone, for example, only by the absence of a double-bonded oxygen atom at position 11 and the absence of a hydroxyl group at position 17, has a potent influence on electrolytic and fluid balance but no effect on carbohydrate, protein and fat metabolism (Best and Taylor, 1950).

TUMOURS OF THE ADRENAL CORTEX

These may occur in either sex and at any age and may even be present at birth.

Although quite a considerable number has now been reported, it is not possible to find in the literature any series large enough to give a reliable guide as to the sex and age group incidence.

In children more attention may be directed to the cases on account of the gross physical changes encountered but the impression gained from the available literature is that rather more cases occur in adults than in children.

As an indication of the incidence of tumour formation, the Riley Hospital for Children, Indiana, during a twenty-six year period had four authenticated cases of adrenocortical tumour in 83,220 admissions (Garrett, 1951). At the Brisbane General Hospital over the last eight years, during which there have been over 300,000 admissions, no case has come to operation and two adrenocortical tumours have been confirmed at autopsy.

At the Brisbane Children's Hospital of 250 beds, there has been one confirmed case over the same period.

It is difficult to state whether adenoma or carcinoma is the more common. Surgeons who have had a very considerable experience with these tumours and have seen a relatively large series of cases are diametrically opposed in their views as to the relative frequency of benign or malignant growths.

One gets the impression that carcinoma is more common than adenoma; in many tumours, however, where microscopical examination after removal reveals early malignant changes, the tumour is still definitely encapsulated and no recurrence is to be expected after total extirpation in such cases (Walters, 1942).

Willis (1952) has drawn attention to the possibility of the presence of metastatic deposits from distant sites in already existing adrenocortical adenomata.

Many classifications of the clinical pictures brought about by these tumours of the adrenal cortex have been made but the most logical seems that proposed by Kenyon (1944).

He recognized six clinical types:

(1) Adrenogenital syndrome.

(2) Cushing's syndrome.

(3) A mixed type combining clinical features of 1 and 2.

(4) A type showing a single endocrine disturbance.

(5) A feminizing syndrome in either sex.

(6) Tumours producing no endocrine disturbance.

It is worth while considering each one of these types in some detail. One must always remember, of course, that no endocrine gland in the body acts independently. The effect on the body of an individual abnormal gland inevitably is influenced by the hormonal activity of the other glands in the integrated endocrine system.

This modifying influence may well account for some of the minor variations which one notices from time to time in the various clinical patterns.

(1) *The adrenogenital syndrome*

The adrenogenital syndrome is one of the most common and dramatic in its manifestations and is due to an over-activity of the androgenic hormones: at the same time there is nothing to indicate over-activity of the corticoid hormones, as no metabolic disturbance, apart from the growth-producing factor of the androgens, and no alteration in blood chemistry or blood pressure, occur.

When a tumour produces excess androgen in a child or adult of either sex there is always a great increase in the 17-ketosteroids in the urine, measured in mgm. per twenty-four hours.

The normal figure up to eight years of age in either sex ranges from 0 to 2 mgm. As puberty is approached, the normal figure for males may rise to 16 mgm. and for females to 9 mgm. (Talbot, *et alii*, 1943). Over a large series it was found that the normal figure for adult males ranged between 8 mgm. and 22 mgm. and for adult females between 5 mgm. and 14 mgm.

The result of this excessive androgen production is an isosexual precocity in males and a heterosexual precocity in females in which they lose their feminine attributes and develop male characteristics.

It has been shown that, in cases where there is an increase in androgenic activity of the cortex, the cells of the cortex stain a vivid red with the differential ponceau-fuchsin stain, whereas cortical cells of a normal adrenal gland take up the aniline blue stain (Broster, 1947).

This same red staining appears temporarily in the foetal cortex of both sexes between the tenth and twentieth weeks of intra-uterine life, suggesting that the female embryo passes through a male phase *in utero*. A persistence of this male phase may account for the relative frequency with which cases of adrenal cortical over-activity in either sex follow the male pattern in their clinical manifestations. In a series of 88 cases of adrenal hyperplasia developing in adult females, Broster (1947) performed unilateral adrenalectomy: he was satisfied that he found a definite correlation between the intensity of the fuchsin stain and the physical condition present and he claims that a small gland with a vivid stain may cause more noticeable clinical changes than a larger gland where the staining is moderate or patchy. However, Cahill and Melicow (1950) comment that they have been unable to find this particular staining consistently present in cases of androgenic over-activity.

The adrenogenital syndrome in the prepubertal male declares itself by an enlargement of the penis, acne, the appearance of facial and pubic hair and increase in height and weight, with no associated obesity but good muscular development. The bone age is ahead of the chronological age and there is premature closure of the epiphyses; spermatogenesis is usually absent but there may be behaviour problems. Quite a number of cases of this type appears in the literature, that reported by Lynch (1950) being typical of the group.

As one would expect, this clinical picture is very like that of macrogenitosomia produced by the androgenic over-activity occurring in interstitial cell tumour of the testis in boys (Fraser, 1949).

When the adrenogenital syndrome occurs in adult males there is an exaggeration of the already existing male secondary sexual characteristics but the changes are not as gross as when the signs appear in childhood.

The adrenogenital syndrome in females results in startling and heterosexual features known collectively as virilism. There is enlargement of the clitoris; absence of breast development if before puberty and diminution of the size of the breasts if after puberty: menstruation fails to occur or if

it has already occurred it becomes irregular and scanty and may cease altogether. Hair develops on the face (hirsutism) with quite often a well developed moustache and beard and there is hypertrichosis on the body: there is also a loss of the female bodily contours with a definite slimming of the hips (Hartmann, 1951).

Naturally, in cases developing in early life, there is an exaggeration of these signs to the extent that pseudo-hermaphroditism may result (Cahill, 1944).

As in the corresponding syndrome in males, the early appearance of virilism in females is associated with rapid growth and physical development and a relatively early cessation of growth.

(2) *Cushing's syndrome*

In these cases there are well-developed metabolic disturbances with no androgenic side effects.

The original conception of Cushing's syndrome was that it was due to a basophilic adenoma of the anterior pituitary gland (Cushing, 1932).

It is now an accepted fact that this syndrome occurs in the absence of a pituitary basophilic adenoma and is, in fact, much more often associated with an adrenocortical tumour with over-activity of the corticoid hormones, a cortico-metabolic syndrome.

There is, however, quite recent experimental work to suggest that, although there is not an actual basophilic adenoma, the basophilic cells of the anterior pituitary may be a motivating force in any Cushing's syndrome (Simpson, 1953).

All the corticoid steroids are involved: over-activity of Compounds A, B, E and F causes gluconeogenesis, raised blood sugar values and serious disturbances of normal metabolism: excessive activity of Desoxycorticosterone causes retention of sodium and water with increased plasma volume and a decrease of potassium in the body fluids (Canterow and Trumper, 1950).

Cushing's syndrome may occur at any age: for some unknown reason girls are more often affected than boys, and it may appear at a very early age as in the case reported by Keifer and Bronstein (1949).

In an established case there is an accumulation of fat on the cheeks and chin with cervico-thoracic pads of fat, giving the Buffalo or Brewer's Drayman face: there is also an accumulation of fat on the trunk and abdomen with a relative lack of fat on the extremities. The facial skin is often plethoric, purplish striae appear on the hips and abdomen and the voice is coarse and deep. The blood sugar level is often high and diabetes may occur while there is also an increase in serum sodium and a decrease in serum potassium and the blood pressure is markedly elevated. Osteoporosis is a definite feature in some cases, the skull, ribs and spine being the areas most frequently involved (Soffer, 1946). Muscular weakness and ecchymoses may also occur.

(3) *A mixed type combining features of both the adrenogenital syndrome and Cushing's syndrome*

These cases occur relatively quite frequently and many cases labelled loosely Cushing's syndrome are, in fact, of this mixed type. They appear repeatedly in the literature, a classical case being the one reported by Harrison and Abelson (1952). The case presented later in this paper also falls into this category.

(4) *A type showing a single endocrine disturbance*

This is more likely to occur with hyperplasia but may occur with tumour. Hirsutism is a feature that may be present in females in the absence of all other signs: here one must be very careful in one's investigation and watch for the development of some additional signs before making a diagnosis, of tumour, for there is, in fact, no sharp dividing line between accepted normality and endocrinopathy; neoplasm has also been known to occur with amenorrhoea or diabetes mellitus as the only obvious sign (Kenyon, 1942).

(5) *A feminizing syndrome in either sex*

There have been a small number of these cases, due to over-production of oestrogen, reported in the literature but they are, in fact, extremely rare (Lisser, 1936), (Cahill and Melicow, 1950).

In males there is a trend towards female characteristics with smallness of the genitalia, loss of libido, obesity and gynaecomastia, while in the very few cases occurring in girls there have been isosexual precocity and metrorrhagia.

6) *Tumours producing no endocrine disturbance*

These tumours are rare in comparison with the first three types described. They may remain unnoticed until pressure effects draw attention to them.

They rarely occur before 35 years of age and may grow to an enormous size.

Lumb (1950) reported two such tumours which weighed 11½ lbs. and 8¾ lbs.: the patients were aged 69 and 57 years respectively. Another case has been described in a man 62 years old, the tumour weighing 10½ lbs. (Walters and Sprague, 1949).

HYPERPLASIA OF THE ADRENAL CORTEX

Symptoms of hormonal over-activity can occur with simple hyperplasia in the absence of actual tumour and the degree of over-activity covers a wide range.

It is interesting to note that a great many boys who win under-age athletic events at school and in inter-school sports never go on to success in the open championships some years later. I have been impressed by the fact that a large number of these under-age champions are big for their age, have early facial hair, external genitals approaching adult type and muscular development one would expect in boys three or four years older. Subsequently, they stop growing at an early age and are then easily outclassed by boys whose progress has been slower but whose steady growth has carried them to full stature and good physical development.

There is good reason to suppose that adrenal cortical over-activity during this growth period is a factor in producing these under-age champions who subsequently fail to live up to their early promise.

Established hyperplasia of the adrenal cortex with associated over-activity of the various hormones is capable of producing a clinical picture identical with that resulting from adrenocortical tumour. A rather startling recent observation is that hyperfunction of the adrenal cortex can or rare occasions exist in the absence of clinically detectable hyperplasia (Priestley *et alii*, 1951).

While once again no large series is available for comparison it would seem from a review of the literature that simple hyperplasia is a condition definitely more common, than tumour of the adrenal cortex.

Sir Thomas Dunhill, in 1931, put forward the suggestion that hyperplasia, adenoma and adenocarcinoma of the thyroid gland in man represented different phases of a transitional process.

Simpson (1953) has recently affirmed that in the same way hyperplasia, adenoma and adenocarcinoma may well be regarded as different phases of a transitional process in the adrenal gland.

Be that as it may, the fact remains that, clinically, hyperplasia and tumour are each very clear cut and distinct entities and it is important to determine whether a tumour is present or not and also, if possible, on which side it lies.

DIFFERENTIAL DIAGNOSIS BETWEEN TUMOUR AND HYPERPLASIA

In quite a percentage of cases a positive diagnosis can be made from a careful clinical examination supplemented by the routine radiological and biochemical investigations. There are, however, a number of more recent tests which are very helpful when it is difficult to decide whether the symptom complex is due to a tumour on one side or to simple hyperplasia, probably bilateral.

One of these is concerned with the estimation of 17-ketosteroids in the urine, which, as already stated, are always increased in the common adrenogenital and mixed types of cortical over-activity whether due to simple hyperplasia or tumour formation.

Escamilla (1949) pointed out that the chemical test for 17-ketosteroids, which has replaced the laborious biological tests for androgens, has stimulated interest in this subject: he goes on to say that, while all 17-ketosteroids are not androgens and all

androgens are not 17-ketosteroids, the results of the chemical test generally parallel the results of bio-assay for androgens and it is now accepted that the test has considerable clinical value. While the excretion of 17-ketosteroids in the urine is, on the average, higher in tumour than in hyperplasia there is such individual variation that this is not of great use as a diagnostic point. However, fractionation of the 17-ketosteroids into the alpha and beta components does provide some reliable information. He brought to notice that experimental work has shown that normally the beta fraction of the 17-ketosteroids is less than 5 per cent. In virilism without tumour the relation of the alpha to beta fraction approximates to 3-1 while in virilism resulting from tumour formation the relation is in the region of 1-2.

Johnson and Nesbit (1947) have reported three proved cases of adrenal cortical carcinoma in which fractionation into alpha and beta components was of definite value in the differential diagnosis: in these particular cases the proportion of alpha to beta fractions was 1-3, 1-4 and 1-1¼.

Wilkins (1951) claims that Cortisone in proper dosage causes a diminution of urinary 17-ketosteroids in hyperplasia but not in tumour; however, he does not quote any specific cases or figures to support this contention.

Gardiner (1951) describes the Patterson-Allen blue colour test as useful in making the distinction and goes on to give the details of the test which can be carried out with the alcoholic residue from the 17-ketosteroid estimation.

It is now possible also to measure the corticosteroids in the urine. At the Mayo Clinic where the chemical method of assay has been in use for some time, it has been found that in patients who have tumours of the adrenal cortex associated with features of Cushing's syndrome, the excretion of urinary corticosteroids is usually increased (Walters, 1952).

TREATMENT

Operative attack on adrenocortical tumours is not new: Collett, in 1924, successfully removed one from a child. In the same year Keyser and Walters reported the removal of a large adrenocortical carcinoma associated with endocrine disturbances. Gordon-Holmes mentioned a case of virilism cured by removal of a cortical adenoma in 1925.

It was soon found, however, that the operation of adrenalectomy in cases of cortical tumour carried a mortality rate in the neighbourhood of 50 per cent.

The patient of Keyser and Walters mentioned above died on the fourth post-operative day: following operation the pulse and temperature rose and there was a low indeterminate blood pressure: the patient never rallied and died in coma. Post-mortem examination revealed a small atrophic adrenal gland on the opposite side.

It was soon realized that there was always a danger of the contralateral gland, in a case of adrenocortical tumour, being atrophic or at least functionally inadequate in the immediate post-operative period.

The introduction of potent adrenocortical extracts some years later provided a means of combating this early post-operative collapse.

In 1938, Walters and Keplar stressed the importance of anticipating and preventing, if possible, post-operative adrenal cortical insufficiency: in their experience, if the patient could be tided over this dangerous post-operative period with the necessary adrenocortical extract and adequate salt intake, the remaining adrenal gland regenerated sufficiently to take over its normal functions.

Over the last fifteen years and particularly since the introduction of individual and more potent adrenocortical extracts, surgical attack on adrenocortical tumours has become a much safer procedure. As evidence of this, Walters (1952) records the removal of hyperfunctioning adrenocortical tumours in 30 consecutive cases without a post-operative death.

As the cortocoid hormones, more than any of the others, are the ones most concerned with that maintenance of bodily equilibrium which is so essential to life, it naturally follows that those patients with Cushing's syndrome or some manifestations of Cushing's syndrome, where there is over-activity

of some or all of the corticosteroids, are the ones most likely to suffer severely from post-operative collapse.

It is important to bear in mind that clinical evidence of beginning post-operative adrenal failure generally precedes any changes in blood chemistry: nausea, vomiting, undue weakness, insomnia, a rising pulse and a falling blood pressure are indications for more energetic preventive treatment.

FIG. I. A front view of the patient showing the fat face with the drooping cheeks and the strongly built body with no corresponding development of the lower limbs.

It is the custom now to give prophylactic Cortisone before operation and to be prepared for whatever post-operative treatment is indicated in the way of cortical extracts, intravenous saline, and diminished potassium intake (Walters, 1952).

In contradistinction to tumour formation, where the contralateral gland is hypofunctioning, simple hyperplasia generally involves both glands and removal of one gland does not, in the majority of cases, control the hormonal over-activity.

Subtotal bilateral adrenalectomy is now under trial and the same pre-operative and post-operative precautions are an essential part of the treatment in the second stage operation.

FIG. II. Side view showing the collection of fat on the trunk.

As far as the operation itself is concerned, the surgical approach is a matter of choice.

Aird (1949) suggests the abdominal route for the left side and a trans-thoracic or subdiaphragmatic loin incision for the right side.

CASE REPORT

History

G.A., aged 3½ years, was presented by his parents for medical examination in August, 1952, as they had become worried about changes in his appearance and in his temperament.

The story was that, at the age of one year, he had been quite normal in every way, but when he was about two years old his mother noticed that he began to develop violent attacks of temper: gradually these outbursts became more violent until he began to damage anything that came to hand.

FIG. III. Antero-posterior X-ray view following air injection and ten minutes after intravenous injection of dye. The tumour can be seen cephalad to the right kidney which is depressed and rotated in an anticlockwise direction. The air has helped to demarcate the tumour from both the liver and the kidney.

At two and one-half years pubic hair was noticeable and downy hair appeared on his arms and back; pimples and blackheads also made their appearance on his face. At about this time it was noticed that his body became progressively fatter although his lower limbs were unaffected.

There was no history of polyuria or polydipsia and no evidence of any functional sexual precocity.

He was the older of two children, the sibling being quite normal in every way; the family history revealed nothing of note.

Physical examination

It was noticed at once that he looked more mature than one would expect and that he had an unusual build with a heavy body and prominent abdomen without corresponding development of the lower limbs. His muscle tone and strength seemed normal and he played well enough with the toys in the waiting room. His face was round and full with drooping cheeks and a rather florid appearance (Figs. I and II).

A mild acne was noticed: there was a definite moustache of soft, light coloured hair and a growth of soft hair on the shoulders.

FIG. IV. Right oblique view after air injection and eleven minutes after dye injection: the tumour—heart shaped in this projection—is clearly outlined overlapping the renal shadow and quite distinct from the shadow of the liver.

His voice was no deeper than normal and his intelligence quite good for his age.

He had long black pubic hairs limited to the area round the base of the penis; the penis was thicker but no longer than normal. The testes were equal in size and rather larger than normal for his age.

His height, 38 inches, was within normal limits, but his weight, 42 lbs., was well above average.

No abdominal mass could be felt.

His blood pressure when first taken was 144 mm. of mercury (Systolic) and 110 mm. of mercury (Diastolic) in the supine position. Physical examination revealed nothing else abnormal.

At this stage he was admitted to the Brisbane Children's Hospital for further investigation.

His blood pressure readings were not easy to record but, during his first fortnight in hospital while he was resting quietly in bed, his systolic blood pressure varied between 130 and 100 mm. of mercury. The fundi were examined and found to be normal.

Ancillary investigations

An X-ray examination of the skull showed a normal pituitary fossa and no intracranial ossification: there was no X-ray evidence of any thoracic or abdominal masses: a mild degree of precocious bone development was noticed but there was no appreciable osteoporosis.

A 24-hour specimen of urine was found to contain 36.7 mgm. of 17-ketosteroids.

A glucose tolerance curve showed a fasting blood sugar level of 115 mgm. per cent.: at one hour after 25 G. of glucose it was 163 mgm. per cent., and after two hours, 129 mgm. per cent. with a trace of sugar in the urine at the conclusion of the test, indicating a slightly diminished glucose tolerance.

The serum chloride, estimated as NaCl was 567 mgm. per cent. and the serum potassium estimation 19 mgm. per cent., both normal figures.

A blood count and microscopical examination of the urine revealed nothing of note.

Although, admittedly, pheochromocytoma is extremely rare in childhood, it was thought desirable to carry out a Benzodioxan test to exclude it, but as soon as he saw the intravenous needle he became violently agitated and his blood pressure rose sharply to 190/140 mm. of mercury. Twenty minutes after the intravenous injection of 10 mgm. of Piperoxane in divided doses, his blood pressure was still 180/110 mm. of mercury: on this evidence alone, pheochromocytoma could definitely be excluded.

At this stage it was felt that pre-sacral peri-renal pneumography combined with intravenous pyelography might help not only in substantiating the provisional diagnosis of adrenocortical tumour but also in indicating the side on which it lay and the size of the tumour if it was indeed present. Under general anaesthesia, 150 cc. of air were injected into the retro-peritoneal tissues on the left side and 200 cc. on the right side in accordance with the procedure described by Blackwood (1952).

Some very interesting X-ray pictures were obtained, the report reading:—

"Before air injection. The renal and adrenal outlines are not defined: one or two small areas of calcification are demonstrated overlying the right lower ribs.

After air injection. The right kidney is well outlined and there is an irregularly rounded mass above it which appears to be a much enlarged adrenal gland: several small areas of calcification are seen within it.

After injection of urodione. The right kidney is rotated in an anti-clockwise direction and the calyces in the upper pole are compressed downwards. This is in marked contrast to the calyces in the upper pole of the left kidney (Figs. III and IV).

Impression. A right adrenal tumour compressing the upper pole of the right kidney. The left renal outline is normal. The left adrenal is poorly outlined but does not appear to be enlarged."

Pre-operative Treatment

100 mgm. Cortone was given intramuscularly fourteen hours before operation and another 100 mgm. six hours before operation.

Two hours before being taken to the theatre a polythene catheter was inserted into the right internal saphenous vein and normal saline was administered until the operation was under way; subsequently, 250 cc. blood were given during the course of the operation.

Operation

Following the technique of Harrison (1952), a long high lumbar incision was made from the 11th thoracic vertebra along the line of the 12th rib and continued obliquely round the abdominal wall. The 12th rib was divided near the angle and resected sub-periosteally; a segment of the 11th rib was also resected to allow an adequate exposure.

Dissection through the peri-renal fascia revealed the tumour lying in a vascular fibro-fatty investing layer which was closely adherent to it.

Immediately the tumour was handled, although it was treated most circumspectly, there was a dramatic rise in the blood pressure which was effectively controlled by the intravenous injection of 5 mgm. of Piperoxane (Table 1).

In this instance, the vessels entering the inferior pole of the tumour were dealt with first and finally the tumour was separated from the inferior vena cava, with which it was in very close apposition.

Post-operative Course

The patient returned to the ward in good condition and next day he was comfortable, although an X-ray examination showed a 20 per cent. collapse of the right lung; this had completely re-expanded four days later.

There was no hyperpyrexia to indicate the necessity for thiouracil which proved so useful in Fowlers case (1951).

Although there were no clinical features to cause alarm, some doubt was felt about the functional capacity of the remaining adrenal gland. In view of previous lack of experience with such cases it was thought desirable to give 50 mgm. Cortone and 25 mgm. Testosterone daily for two days after operation.

TABLE 1

THE ANAESTHETIC RECORD INDICATING THE SUDDEN AND DRAMATIC RISE IN BLOOD PRESSURE DURING THE COURSE OF THE OPERATION

ANAESTHESIA RECORD

Date.. 8/9/52

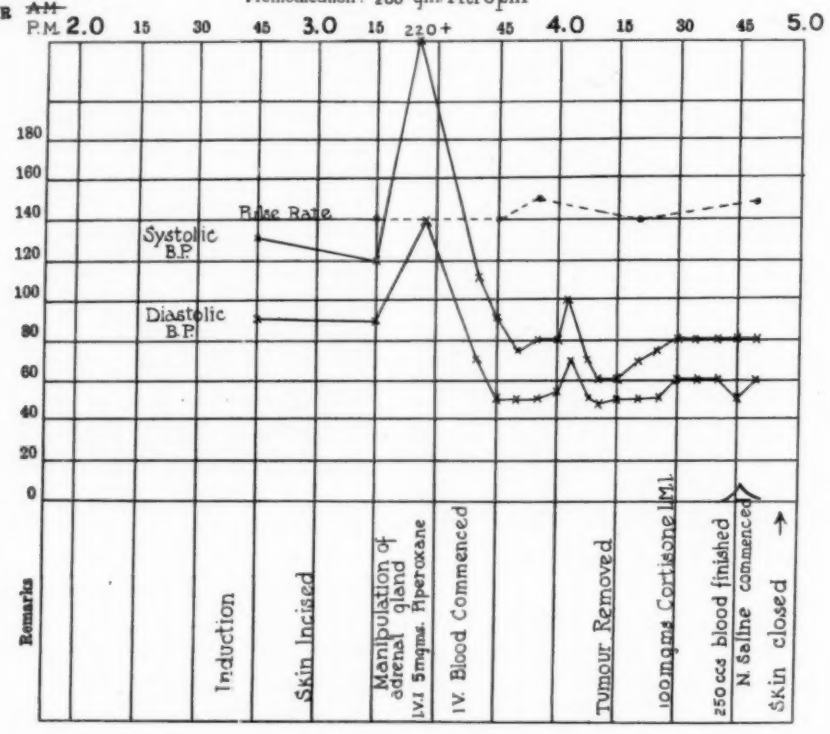
Operation: LAPAROTOMY

Surgical Risk A/B/C/D

Anaesthetist: Dr R. Robinson

Surgeons: Mr. K.B. Fraser, Mr. P. Row

Premedication: 1/200 gm. Atropin



Induction: 0.25 pentothal +2.5 mgm tubarine

Maintenance 1.5 mgm tubarine $N_2O + O_2$

Anaes Technical Difficulties: —

Operative Findings: Tumour of right adrenal gland

Circulatory Depression 1st/2nd/3rd

Resuscitation: —

Reflexes on leaving Theatre swallowing/ vomiting/ coughing

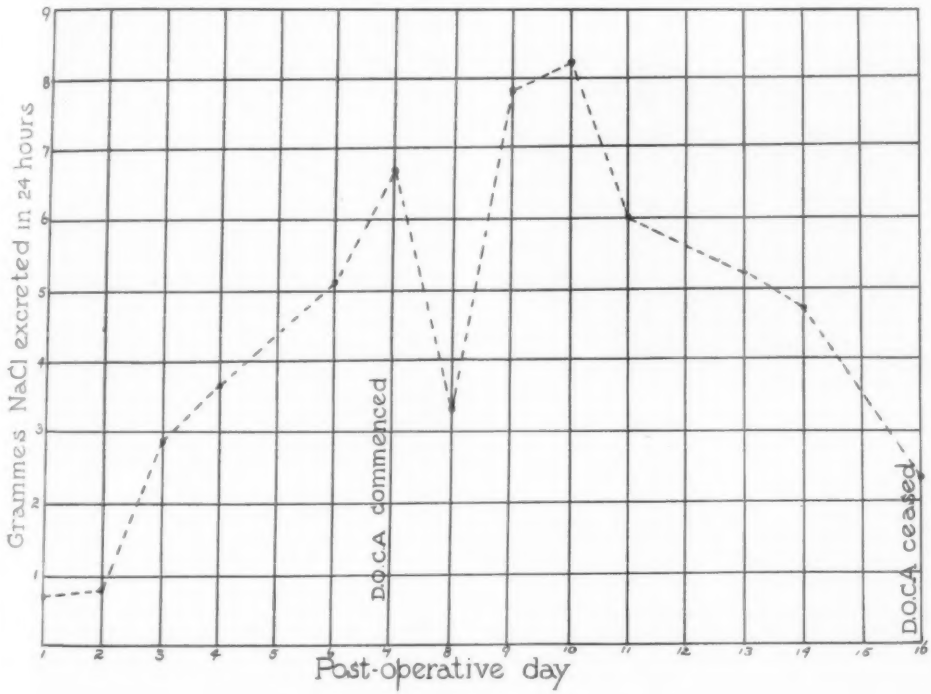
Technique: I.T. intubation to and fro closed circuit CO_2 reabsorption

At the same time, a careful watch was kept on the daily urinary NaCl output. As this rose steadily until it reached 6.6 gms. on the seventh post-operative day, 20 mgm. of DOCA in the form of Primocort was given intramuscularly daily for two days and then 10 mgm. daily for another 8 days by which time the daily excretion of NaCl had dropped to 2.3 gms. (Table 2).

It is interesting to note that for the first three weeks following operation, the systolic blood pressure remained between 150 and 110 mm. of mercury and the diastolic between 110 and 70 mm. of mercury: however, on the twenty-third day, it had dropped to 105 systolic and 75 diastolic, at which stage he was discharged from hospital.

TABLE 2

A GRAPH RECORDING THE TOTAL DAILY EXCRETION OF NaCl IN THE POST-OPERATIVE PERIOD



A child of the same age and on the same diet was used as a control on this day and was found to have a urinary excretion of 2.1 gms. NaCl and DOCA injections were accordingly ceased.

During all this time a careful watch was kept on the daily urinary output which remained within normal limits throughout.

On the eighth post-operative day the serum chloride, estimated as NaCl was 583 mgm. per cent., the serum potassium 20.7 mgm. per cent. and the fasting blood sugar, 107 mgm. per cent.

Three weeks after operation, a 24-hour specimen of urine contained less than 1 mgm. of 17-ketosteroids compared with the pre-operative figure of 36.7 mgm.

Pathological Report

Macroscopic. The specimen was an approximately ovoid tumour with a regular surface relieved at several points by low nodular projections. It measured 7.1 cms. x 5.6 cms. x approximately 5 cms. in its major axes; it was not weighed. An apparently intact fibrous capsule covered the mass and to this were attached an occasional fibrous tag and some lobules of fat. No evidence of the breach in this covering suspected by the surgeon could be found after careful examination of the surface.

Bisection through the long axis of the growth revealed division of the total lesion into two macroscopically distant masses of tissue each forming one pole of the neoplasm with an irregular

stratum of greyish, mottled-with-yellow, necrotic material of maximum thickness about 3 mms. interposed between them. The larger of the two masses was a deep reddish brown with an almost haemorrhagic appearance and was composed of numerous, in most cases poorly defined, nodules of spherical or ovoid form which showed some deformity caused by mutual compression. The biggest nodule measured about 5 mms. in diameter and was outlined, like some of the others, by a thin, greyish capsule; many, however, merged with one another along their margins.

The smaller mass was of light buff colour and did not show the same degree of organisation into nodules as its companion (Fig. V).

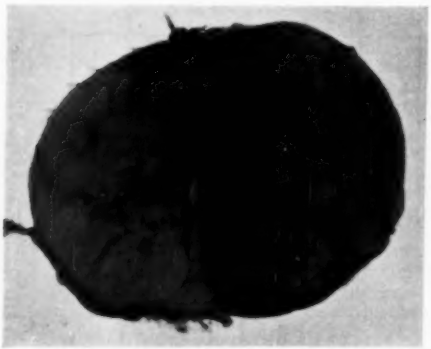


FIG. V. A view of the bisected tumour showing its division, by a necrotic stratum, into two distinct sections.

Microscopic. The growth has the structure of an adenoma of the adrenal gland. It is composed of extensive sheets of polygonal cells which have for the most part eosinophilic granular cytoplasm and a conspicuous, finely vesicular nucleus.

Vacuolation is minimal, but, around the periphery, its presence combined with an imperfectly radially disposed trabecular architecture gives a reasonable mimicry of the adrenal cortex from which the lesion arose. However, this resemblance is superficial for no sudanophilic lipoid is demonstrable here or in other parts of the tumour except where degeneration is probably present. Polarized light disclosed scattered sheaves of doubly refractile crystals, most frequently in association with islets of neoplastic cells which are larger and more loosely arranged than the majority of those making up the remainder of the growth. Other features of the sections include small foci of degeneration leading to pinpoints of necrosis and early calcification in the necrotic stratum which bisects the lesion (Fig. VI).

Subsequent History

When seen three months after the operation, his face was less bloated: he had regained the childish look natural for his age and the acne on his face had disappeared. Pubic hair, although still present, was less marked and the penis was definitely smaller. He had lost 5 lbs. in weight and his blood pressure was 80-60 mm. of mercury.

On examination in March, 1953, six months after the operation, the improvement in his general condition had continued, the blood pressure was still 80-60 mm. of mercury, and the 17-ketosteroid urinary excretion had remained low at 1.4 mgm. in 24 hours.

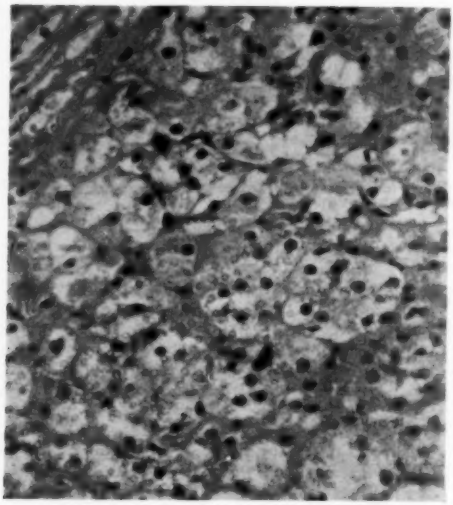


FIG. VI. The subcapsular portion of the growth showing the vacuolated nature of its polygonal cells. A portion of the fibrous capsule is included in the field. (x 256)

DISCUSSION

This small boy had a typical mixed type of tumour, the enlargement of the penis, the facial and pubic hair and the advance in bone age following the androgenic pattern and the accumulation of fat on the trunk, the heavy facies and the marked elevation of blood pressure conforming to Cushing's syndrome.

A provisional diagnosis of right sided adrenal tumour could reasonably have been made on the clinical examination aided by the intravenous pyelogram. On the other hand, there is no doubt that, in this instance, the peri-renal injection of air made the diagnosis more certain and gave positive evidence about the size of the tumour.

There does not seem to be much risk with pre-sacral pneumography when using the technique employed here: in fact, it is in the diagnosis of doubtful adrenal tumour that this manoeuvre finds its greatest use and it should be availed of without hesitation for this purpose.

The operation itself presented some technical difficulties, partly due, no doubt, to inexperience in adrenal gland exposure: there is general agreement, however, that the operation on the right side is the more difficult one, due to the close association of the tumour, on its medial side, with the inferior vena cava.

The management of the pre-operative and post-operative phases presented some problems: it is obvious, however, that preventive measures are most important in the avoidance of fatal post-operative collapse.

The periodic estimation of the urinary 17-ketosteroids after operation gives a good guide to the ultimate prognosis: the reading, after an initial drop following removal of the tumour, always rises rather rapidly if there is any recurrence or metastatic spread.

In this instance, in view of the favourable pathological report and the recent 17-ketosteroid reading which was 1.4 mgm. compared with 36.7 mgm. before operation, one can, with reasonable certainty, look forward to a permanent recovery.

Admittedly, adrenocortical adenoma and carcinoma are quite rare tumours: however, apart from the very varied clinical pictures they present, the interest in their study lies in the necessary close collaboration between the experimental scientist, the pathologist and the practising surgeon.

The complete answer to the many problems associated with the hormonal activities of the adrenal cortex has not yet been found and this fact alone may reasonably warrant a detailed report of an individual case such as that presented here.

SUMMARY

The hormones of the cortex of the adrenal gland and their known functions are discussed.

The different syndromes caused by tumours of the adrenal cortex are described, and the influence of the various hormones in the causation of these syndromes is considered.

Mention is made of the importance of distinguishing between simple hyperplasia and adenoma or adenocarcinoma of the adrenal cortex.

A brief account is given of some of the more recent biochemical advances which aid in the diagnosis of adrenocortical tumour.

Some aspects of the surgical treatment of adrenocortical tumour are given, including the value of adequate post-operative supportive treatment when required.

A case of adenoma of the cortex of the right adrenal gland in a boy of 3½ years is presented in detail.

ACKNOWLEDGEMENTS

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THE BLOOD SUPPLY OF THE THYROID GLAND

I. THE NORMAL GLAND

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THE thyroid gland and its blood vessels have been the subject of a large number of investigations over many years. These investigations have dealt almost solely with the normal gland as found both in the human and in the experimental animal. The vessels of the pathological organ have received but scant attention. The present study was undertaken in order to investigate the changes in vascular architecture which occur in the various pathological states found in the thyroid gland.

The blood supply of the normal gland has been reasonably well worked out but there are several minor points which give rise to argument. In order to form some opinion on these points and to standardize the techniques used for the investigation, the normal structure formed the initial part of these studies.

Historical Review

The rich blood supply of the thyroid gland has been recognized since early in the nineteenth century and many explanations have been given for this extreme vascularity. At one time the thyroid, being highly vascular and superficially situated, was regarded as a cooling organ for the blood. Another school maintained that the gland played the roll of a buffer—protecting the brain from sudden changes in blood flow.

Anna Bégoune (1884) was one of the earliest investigators to attempt systematic study of the thyroid vessels. She used an injection technique and, in her writings, makes passing mention of the paucity of blood supply to some types of thyroid nodule.

In 1909, Major published a careful account of thyroid vascular anatomy. He again used an injection technique and, after injecting both human and animal glands, concluded that the thyroid was a lobular gland with a lobular blood supply.

In the early days of thyroid surgery the management of cases of severe thyrotoxicosis presented great difficulty and, as is well known, the method of staged operations with ligation of the major vessels as the first step was evolved. This naturally raised the question of the pattern of the main vessels. Numerous investigations into this problem were carried out and the site, size, and frequency of anastomosis between these main vessels were described by several authors. Their conclusions have been well dealt with in papers by Mastin (1923), Stewart (1932), and Wangensteen (1929) and will not be further discussed in this paper.

Whilst studying the activity of thyroid epithelium transplanted into a chamber in the ear of a rabbit, Williams (1937) noted that the capillary bed surrounding each individual vesicle was extremely labile, and that its pattern changed constantly with variations in the activity of these vesicles. In a further study of living thyroid tissue, Williams (1944) showed the intimate association of the capillary plexus and vesicle. He micro-dissected the living gland and found that the capillaries adhered to and moved with a vesicle when it was displaced.

Lewis-Thomas (1945) observed the thyroid vessels in rats and studied their variations after administration of anti-thyroid drugs such as thiourea. He used an injection method and described two types of capillaries around the vesicles:

(a) wide vessels on the vesicle surface;

(b) narrow capillaries embedded in the epithelial wall of the vesicles.

No evidence for these two types of capillaries has been reported in the human gland, nor did the present investigation give any indication of such a pattern.

MATERIAL

The material examined consisted of post-mortem and operative specimens. It soon became apparent that surgically removed glands were unsuitable for investigation by injection methods. All blood vessels severed at operation "bleed" freely on introducing the injection mass, and although this "bleeding" can be controlled by the usual surgical measures, the resulting specimen is unsatisfactory. For this reason only post-mortem specimens were used for injection experiments.

Thirty-six normal glands have been investigated by the methods to be described below.

METHOD OF INVESTIGATION

Injection

In examining routine histological sections of the thyroid gland, blood vessels may be frequently observed. It is, however, quite impossible to gain an accurate picture of the vascular pattern by this means. For this reason an injection technique was developed, using a gelatine medium as the injection mass. This method has been widely used in various investigations of vascular architecture. The technique used was evolved out of that described by Gross (1921).

Two different injection masses were used. Their composition is as follows:—

(A) Carmine-gelatine

A solution of 10 gm. of soluble carmine in 300 cc. of water is prepared. To this solution 6 cc. of ammonia is added, drop by drop, stirring continually. Now a solution of 100 gm. of granulated gelatine in 200 cc. of warm water is prepared. This is carefully mixed with the carmine solution and 4 cc. of acetic acid added.

The mixture is now heated to about 80°C, approximately 1 gm. of thymol added and it is filtered. The solution is now ready for use.

(B) Barium sulphate-gelatine

Mix carefully together:

100 gm. of granulated gelatine,
300 gm. of finely ground barium sulphate,
550 cc. of water.

This is heated to about 80°C stirring continuously, about 1 gm. of thymol added and it is filtered. The solution is then ready for use.

Both of these masses were injected routinely at a temperature of 60°C and at a pressure of 250 mm. of mercury.

The carmine-gelatine mass was found to enter the capillary bed quite readily and uniform filling could be obtained without great difficulty (Fig. V). The barium-gelatine mass would penetrate only as far as the smaller arteries and none could be found in the capillaries.

In order to allow time for post-mortem spasm of the arteries to subside, all glands were left for at least eighteen hours after death before being perfused. During this time the gland was allowed to remain at room temperature. Prior to perfusion the blood vessels were washed through with normal saline until the fluid flowing from the veins became clear. In addition to clearing the vessels of blood this also had the effect of rendering the gland oedematous, thus separating its lobules and making histological interpretation easier.

The lobes were perfused via the superior or inferior thyroid artery and it was found that in general the inferior vessel supplied about two-thirds of the corresponding lobe. Perfusion was continued for fifteen minutes or until the medium was seen to fill the veins. The gland was then cooled, fixed in formalin and examined after a lapse of at least forty-eight hours; which time was required for adequate fixation in these circumstances.

Such material, having been left unfixed for some hours after death, and having been subjected to the insults of perfusion is of limited value for routine histological examination and are quite unsuitable for any cytological study.

On cutting thin sections of a carmine-gelatine injected gland by the usual methods and examining them unstained, the capillaries can be clearly seen (Fig. I). However, only short lengths of the capillary occur in such a thin section and the major vessels can only occasionally be found. It was found that the most informative preparation could be obtained by the frozen section method, with the microtome set at 100-150μ. In such thick tissue sections the capillary pattern was easily made out and the finer vessels could be traced over a significant part of their course. Even when using such preparations chance played a major role in the display of vessels and most sections proved of little value.

FIG. I. Photomicrograph of an unstained routine histological section of injected thyroid gland. Only very short lengths of vessels are seen. Much injection material has fallen out during preparation. Compare Fig. V in which much greater detail of the vascular pattern may be appreciated. (x 150)

Barium-gelatine injected glands can be investigated either by means of X-ray or by clearing the tissues. Both methods were employed, but X-ray examination was found to be of little value; blood vessels travelling in different planes in the specimen obviously cast overlapping shadows and these gave rise to a complex picture which is usually impossible to interpret.

Micro-dissection

An attempt was made to micro-dissect some of the glands and much useful information was gained in this fashion. A slab of thyroid 1-2 mm. in thickness was cut from the fixed specimen and placed in concentrated hydrochloric acid at room temperature for twenty-four to thirty-six hours. At the end of this period considerable softening of the fibrous tissue had occurred and the parenchyma of the gland could be readily teased apart. However, such treatment also rendered the arterial walls friable and this made the method somewhat difficult to employ effectively.

RESULTS

The blood vessels in the thyroid gland run in fibrous tissue septa which separate the various components of the gland. In order to describe these vessels it is necessary to have a clear concept of thyroid structure.

The minute anatomy of the human thyroid

Many have attacked this problem and yet it can not be stated that a generally acceptable view has been evolved. Major (1909) described the gland as a lobular structure. Williamson and Pearce (1923 a and b, 1925) carried out much work on this problem and concluded that the thyroid parenchyma consisted of long coiled tubes enclosed in lymph spaces. However, their conclusions, though possibly applying to some stages in the development of the gland, are no longer accepted as being generally applicable.

The problem has been extensively investigated by Reinhoff (1929) who used the methods of wax-model reconstruction and micro-dissection. He concluded that there was "not the slightest evidence of true lobulation in the thyroid gland." In his published illustrations, the parenchymatous tissue when stripped of its connective tissue and vascular surroundings, resembled irregularly branching coral.

When sections of the normal thyroid are examined, however, one is struck by the fact that the amount of fibrous tissue separating the various components is small. There is hardly sufficient tissue to constitute easily recognizable septa. Now, in Reinhoff's method, it would appear that fine septa could easily be missed.

Furthermore, Reinhoff obtained the branching coral-like structure when reconstructing a block of tissue. Had he turned this block through a right angle he may have obtained a similar structure; as far as can be ascertained, no attempt was made to do this. A point that has been overlooked here is that wide-reaching conclusions should not be drawn from one method of study.

FIG. II. Photomicrograph of a thyroid lobule with its artery and vein obtained by micro-dissection. The artery is clearly seen and behind it, slightly out of focus, the companion vein may be observed. (x 50)

It is apparent, however, that his irregular columns of thyroid parenchyma may be further subdivided into lobules. In the injection method employed in this investigation the gland was perfused for a considerable period of time with saline, thus rendering the gland grossly oedematous. On examining such a gland, spaces of cleavage are found between lobes and lobules. The vesicles which form these lobules do not become separated but remain bound together and this fact gives strong evidence for the lobular nature of the gland. Furthermore, on examining injected glands, lobules can be dissected out with their blood supply intact (Fig. II). This cohesion of vesicles and particularly the characteristic vascular supply are the peculiarity of lobules of all glands; it is merely the absence of a duct in the thyroid which makes the problem more difficult and the distribution of blood vessels resolves this.

It is clear that the method of separation of the lobules by saline perfusion gives information not obtainable by the methods of wax-model reproduction. In these models the close apposition of lobules prevents the recognition of these as distinct structures.

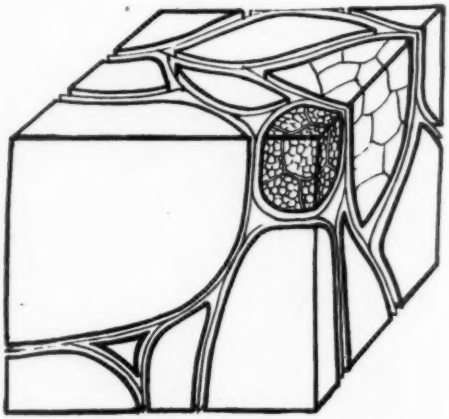

FIG. III. Diagram showing structure of a block of tissue of the thyroid gland. Many structural lobes are illustrated. In one of them the subdivision to lobules is shown and, in another, the vesicular structure of the lobules may be observed.

In the adult gland the thyroid lobule may be taken, therefore, as it is in other organs, as the unit of structure. This lobule is made up of thyroid vesicles, each lobule consisting of 20-40 vesicles bound together by fine connective tissue and, as stated, each has its own blood supply. The lobules are in turn collected together to form the "structural lobes" of the gland, each structural lobe comprising many lobules and taking the form of an irregular disc of tissue. Each disc is separated from its neighbour by a fine sheet of fibrous tissue and many of these discs, bound together, make up the anatomical lobe of the thyroid.

These points are illustrated diagrammatically in Fig. III. They can be rendered apparent by perfusing the gland with warm saline via the inferior thyroid artery for at least thirty minutes. After fixation the cut surface clearly shows the structural lobes (Fig. IV) and histological section of such a gland shows the lobules (Fig. V).

FIG. IV. Photograph of a section of "oedematous" thyroid gland. The structural lobes are clearly shown. (x 1½)

The arteries of the thyroid gland

Arterial blood reaches the gland by way of four vessels: the right and left superior and inferior thyroid arteries. Occasionally, a fifth, the thyroidea ima artery is also present. The arrangement of these major vessels is so adequately dealt with in the various textbooks of anatomy that no further description is required. On reaching the gland, these vessels run over its surface, and anastomose frequently. The thyroid gland, like the brain, bears its major vessels on the surface.

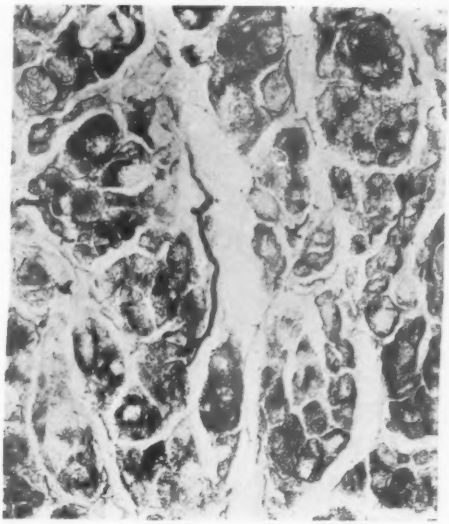

FIG. V. Photomicrograph of a thick section of injected thyroid gland (unstained). The structural lobes and lobules may be observed. Note that the capillary bed seen in the vesicular walls is well filled. (x 10)

Branches from these major vessels then plunge into the gland and run between the structural lobes (Fig. VI). These vessels branch in an irregular fashion and, disappearing into the structural lobe, break up into branches of supply to the lobules. A structural lobe may receive two or more such arteries.

Each lobule usually receives a single small artery and this point is of fundamental importance in understanding the changes in vascularity which are observed in a nodular gland. Sometimes a single lobule receives two arteries but this fact in no way opposes the general proposition: one lobule, one artery.

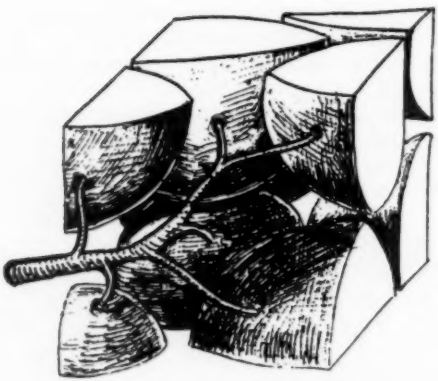

FIG. VI. Diagram of a dissected block of tissue showing the blood supply to the structural lobes. For the sake of clarity the structural lobes are shown as regular masses and these masses are widely separated for the same reason.

The artery of supply enters the lobule and breaks up into branches to the individual vesicles (Fig. VII). In some cases, the vessel becomes dilated and tortuous before breaking up into its vesicular twigs (Figs. VIII and IX). Each vesicle ultimately receives a small terminal twig which breaks up to form a capillary plexus and this varies considerably in both its density and in the diameter of its component capillaries (Figs. X and XI).

FIG. VII. Photomicrograph of a thick section of unstained injected thyroid gland. Three small lobules may be observed and each may be seen to receive a small artery as indicated by the letters A, B and C. (x 75)

FIG. VIII. Photomicrograph of an injected thyroid lobule, removed by micro-dissection. The artery, vein, and capillary plexus may be seen. Note the tortuous and dilated area of the artery before it breaks up into arterioles. (x 75)

The pattern of the veins follows that of the arteries and the description given previously need not be repeated. As might be expected, the walls of the veins are much weaker than those of the arteries. Perfusion of the veins at pressures of 90-100 mm. Hg. will result in rupture of the vein and extravasation of gelatine into the tissue.

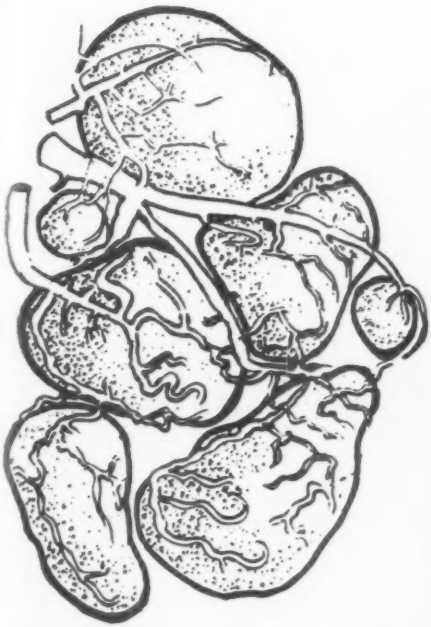

FIG. IX. Diagram showing the general arrangement of blood vessels shown in Fig. VIII. A thyroid lobule is represented and a few of its component vesicles are outlined.

Anastomoses of the vessels within the gland

(a) Arteries

There is no disagreement about the frequent anastomoses of the major vessels on the surface of the gland. They are readily found by the most casual observer.

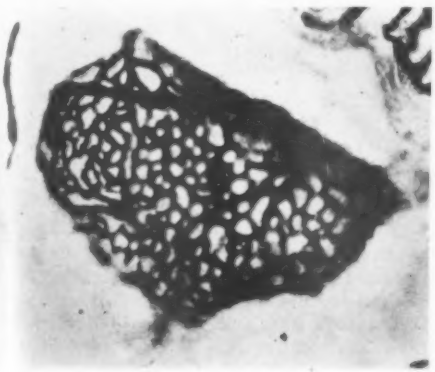

FIG. X. Photomicrograph of a section of unstained injected thyroid. A dense capillary plexus round a vesicle is shown. Compare Fig. XI which shows a loose capillary plexus. (x 150)

However, conflicting opinions have been expressed regarding arterial anastomoses within the substance of the gland. Major (1909) and Marine (1928) state that no such anastomoses occur. On the other hand, Shigyo (1926) states that they are uniformly present throughout the gland and Modell (1933) claims to demonstrate them by methods of silver staining in the thyroid of the dog.

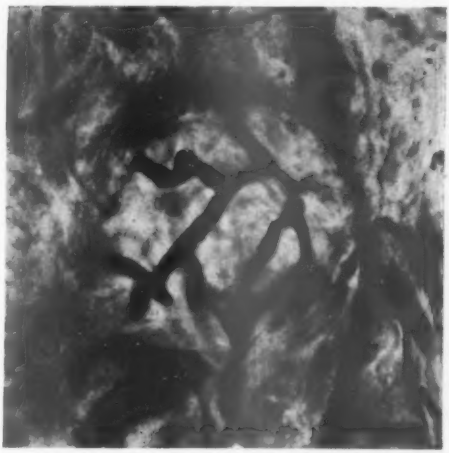

FIG. XI. Photomicrograph of a section of unstained, injected thyroid gland. A loose capillary plexus is seen. Compare Fig. X which shows a dense capillary plexus. (x 150)

The problem is not a simple one. It must be realized that the lobules of the thyroid vary considerably in both shape and size, and that they are closely packed in the gland. Now the vessels weave between these lobules in an irregular fashion and the probability that a convincing arterial anastomosis could be demonstrated by histological section is remote. Micro-dissection might be supposed to be more applicable in such circumstances, but here again the technique is difficult. Nevertheless, sufficiently careful examination of many specimens demonstrates their existence and in this series of experiments, it has been possible to dissect out an arterial anastomosis from a barium-gelatin injected gland on several occasions, and such an anastomosis is shown in Fig. XII.

(b) Veins

The veins are easily observed to anastomose with great frequency both on the surface and in the depths of the gland and there is no significant difference of opinion regarding this.

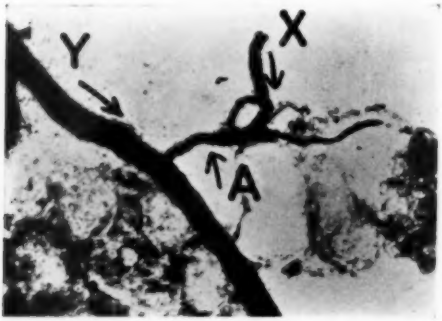

FIG. XII. Photomicrograph of an intra-glandular arterial anastomosis micro-dissected out from a barium-gelatin injected gland. An anastomotic vessel "A" is shown joining a lobular artery "X" and a larger vessel "Y." Under the dissecting microscope the variation in calibre of the vessels was more apparent than is shown in the photograph. (x 40)

(c) Arteriovenous anastomoses

On examining the necks of many patients suffering from thyrotoxicosis, one cannot fail to be impressed by the signs of vascularity of the thyroid gland. Such a gland frequently pulsates visibly and, on auscultation of the neck, the well-recognized bruit is audible. Furthermore, if a toxic gland be exposed at operation, the high degree of oxygenation of the venous blood draining from the thyroid vessels is a striking feature.

This triad of pulsation, audible bruit and high oxygenation of the venous blood is strongly suggestive of the presence of arteriovenous communications. Of course, wide dilatation of capillaries will give this in some measure but, when present in gross degree, the phenomenon deserves thorough study.

Modell (1933) describes such communications in his preparations of the dog's thyroid. He used a silver impregnation method, and concluded that shunts between the smallest vessels occurred with considerable frequency and that they could occasionally be found between the larger interlobar vessels.

In the present series of experiments only indirect evidence for the existence of arteriovenous shunts has been obtained. Occasionally, on injecting a gland, venous filling readily occurs after a short period of perfusion, but when sections of the tissue are made, one may find arterial and venous filling without any evidence of injection of the capillary bed (Fig. XIII). Such an occurrence suggests that the veins filled by way of arteriovenous shunts but, owing to technical difficulties, direct demonstration of such shunts has not been obtained.

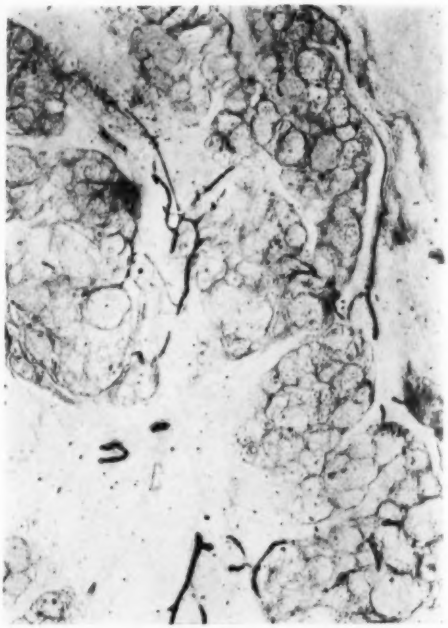

FIG. XIII. Photomicrograph of a thick section of unstained injected thyroid gland. In this specimen arterial and venous filling were obtained and yet, as can be seen, little if any dye has entered the capillary bed. (x 10)

CONCLUSIONS

Although the structure of the thyroid gland as an agglomeration of vesicles is unquestionable, there is controversy regarding their disposition and arrangement. Although over forty years ago evidence was adduced for their aggregation into lobules in a manner comparable with that exhibited in glands with ducts, this view has been opposed. In the present paper, evidence in support of the lobular structure is given.

In circumstances when the small amount of connective tissue is emphasized by making the tissues "oedematous" (by injection of vessels with saline) the lobular character of the glandular tissue becomes clear. When this is appreciated clearly, the significance of the relatively fine strands of connective tissue seen in ordinary sections becomes apparent.

More important here is the anatomical relation of the smaller branches of the thyroid arteries. Small vessels are shown to supply, individually, groups of vesicles; each of these constitutes a definite aggregation surrounded by a small amount of connective tissue which separates it from adjacent similar masses. It is this blood supply consisting of a small artery which establishes the masses as separate and distinct structures.

A further point over which there has been controversy is the presence of intra-glandular arterial anastomoses. Anastomoses on the surface of the gland are incontrovertible. Definite evidence of anastomoses in the substance of the gland is provided here. The presence of arteriovenous anastomoses (shunts) has been described and some circumstantial, though inconclusive, evidence has been provided in its support.

The question of the vascular anatomy of any organ is clearly one of some importance. In the thyroid gland, vascular pattern probably plays an important part in our understanding of the production of nodular goitre and in the evolution of the pathological processes occurring in such nodules. The vascular pattern in thyroid nodules and the changes in such patterns which may be observed in association with haemorrhage and necrosis in nodules will form a further part of this study.

SUMMARY

1. A series of thirty-six normal thyroid glands has been studied by injection and micro-dissection.
2. A method of saline perfusion to render the gland oedematous has been described. It is demonstrated that this method aids in the elucidation of glandular structure.
3. It is shown that the thyroid has a lobular structure. Each lobule is made up of vesicles bound together by fine connective tissue and receives its own blood vessel.
4. Many lobules, bound together by fine connective tissue make up the structural lobes, which are in turn aggregated together forming anatomical lobes.
5. Evidence is presented to show that intra-glandular arterial anastomoses do occur.
6. In this investigation the only evidence found for the presence of intra-glandular arteriovenous shunts has been indirect, and is considered to be as yet of uncertain value.

ACKNOWLEDGEMENTS

I am indebted to Dr. J. D. Hicks, Pathologist to the Royal Melbourne Hospital, for the many thyroid glands used in these experiments, and to Dr. J. Freidin, for his help with the diagrams.

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BASAL CELL TUMOUR OF THE MALAR BONE IN A CHILD

By B. K. Rank
Melbourne

THE origin of most epithelial tumours involving bone is usually obvious. They are either invading from an extra-osseous site at which they arise or else are metastatic in type. There are, however, some epithelial tumours of bone whose origin is not apparent; and these usually occur in bones which are related topographically to skin, mucous membrane or their derivatives. The well known example of this kind is the adamantinoma of the mandible and less commonly a growth, histologically similar, is observed in the tibia or the ulna. These tumours are all fundamentally a basal cell type of epithelial growth, though they may show special differentiation. It is perplexing that the misleading term "adamantinoma" is often applied to these tumours even when they occur elsewhere than in the jaw.

It is the purpose of this note to record the occurrence of a basal cell tumour in yet another subcutaneous bone—the malar. One can find no reference in the literature to this site of a tumour of this nature. Apart from the age of the patient, it is remarkable in that the tumour was in and expanding from the bone without any involvement of the overlying skin. A history of a subcutaneous soft tissue nodule, however, strongly suggests that it arose in the deeper adnexae of the skin and invaded the bone secondarily. This example may well have some bearing on the mode of development of all tumours of this type.

Case Report

A girl, aged 14 years, was referred for surgical management of a tumour of her face (Fig. Ia). There was a fixed, hard mass in the left zygomatic region, filling the infratemporal fossa. It was covered by an area of atrophic skin showing post radiation changes. There was no irregularity of the bony orbit and the jaw function was normal.

FIG. I. The facial appearance—(a) Prior to operation.
(b) After excision of the mass.
(c) After reparative surgery.

The history of her condition was as follows:—When the girl was 11, her mother first noticed a small lump under the skin overlying the left malar region. She insists that this lump was moveable under the skin. There was no history of injury and the child was otherwise well. Advice was sought one week after the lump was first noticed, on

which occasion, 16th October, 1947, a "hard swelling over the zygomatic arch with some local tenderness" was noted. X-ray (Fig. IIa) showed "an irregular area of bone absorption in the zygomatico-temporal suture line." At a further examination four weeks later it was reported that the swelling was enlarging; it was then about one inch in diameter and again noted as lying superficial to the zygoma. After a further four weeks the mass appeared to have extended further forwards and a further X-ray showed increased destruction of the zygomatic arch. A diagnosis of osteogenic sarcoma was made and the case was referred for radiotherapy.

The report of the histological examination of the specimen read as follows (Figs. III, IV, V, VI):—

(1) "The mass contained new bone formation among which were large areas of an active 'basal cell' tumour.

(2) "Surrounding muscular tissue was clear but for fibrosis.

(3) "The nodule from the antrum was 'chronic inflammatory' only"—(Dr. E. S. J. King).

Eighteen months after operation, as there was no evidence of recurrence and the patient was naturally concerned about her residual disfigurement (Fig. Ib), a programme of repair was commenced. In a three-stage procedure, an open indirect flap was migrated from the abdomen via the wrist to replace the skin area of radiation dermatitis, and to fill the contour defect with fat. Six months later, cancellous bone chips were arranged beneath the flap to improve contour about the orbital region, and some re-arrangement of the anterior margin of the flap was subsequently carried out.

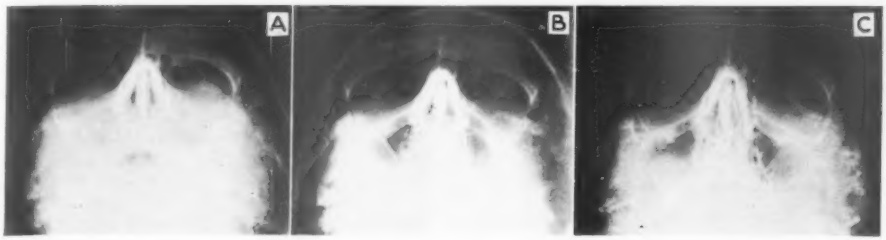

FIG. II. Radiological appearances—(a) The condition when first X-rayed. 16th October, 1947.
(b) Four months later—prior to radiotherapy, 27th February, 1948.
(c) After radiotherapy and prior to operation, 1st April, 1949.

Four months after it was first observed, the mass was described as "still enlarging and centred on the zygoma; but superficial to it." Fig. IIb shows the condition at this time, 27th February, 1948. An aspiration biopsy was inconclusive—"osteoid tissue and calcification in soft tissues." Two courses of X-ray therapy were given with reduction in the size of the mass, and seven months after the second course of treatment, the case was referred for surgical excision of the mass. There was pain at that time.

Total excision of the mass and the malar bone was planned and carried out on 24th June, 1949.

Operation. Through a transverse incision on the line of the zygomatic arch curving down anteriorly into the eyelid, after dissection of some facial nerve branches, a large mushy and honeycomb tumour of the zygomatic arch itself was disclosed. There was little extension along the infraorbital ridge or to the antral region, but much extension backwards and medially. It filled the infratemporal fossa and extended back around the temporomandibular joint region. The mass and the malar bone were removed together with the upper and outer wall of the antrum, some of the infarorbital plate and the zygomatic process of the temporal bone. The joint was opened. But for a small submucous nodule which was removed for section, the antrum itself was clear and the antral mucosa was closed. The external wound was closed with drainage of the cavity. Primary healing followed.

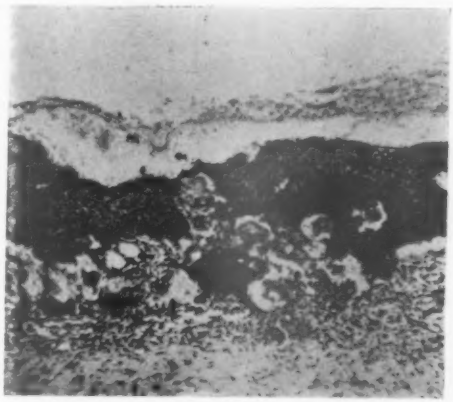

FIG. III. Photomicrograph of portion of the tumour invading the zygoma. This shows a portion of the wall of a small cystic space. The wall is lined by masses of epithelium of the basal cell type. (x 75)

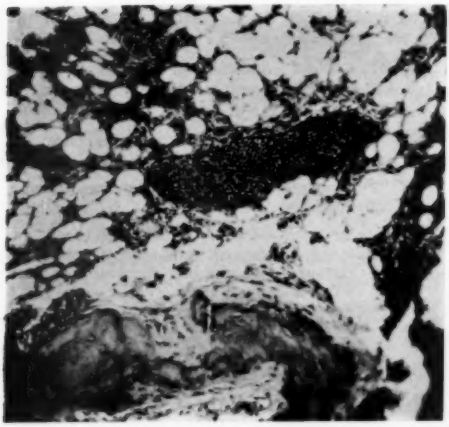

FIG. IV. Photomicrograph of portion of the zygoma showing a mass of epithelial cells in the fat adjacent to a bone trabecula. (x 75)

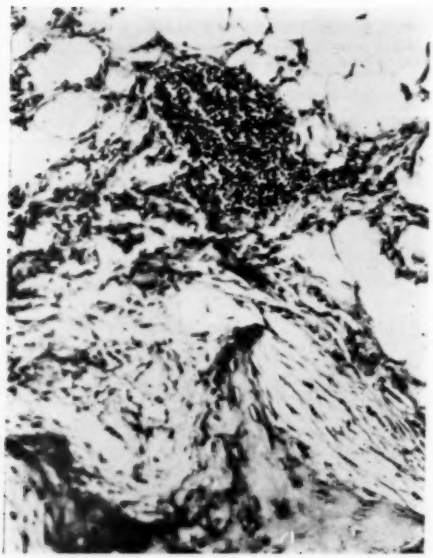

FIG. V. Photomicrograph of another portion of the bone showing a collection of epithelial cells of the basal type lying in fat near a bone trabecula. (x 150)

The present condition four years after operation is shown in Fig. Ic. There is no evidence of tumour recurrence, but some of the bone graft has absorbed. The patient is fit and happily married.

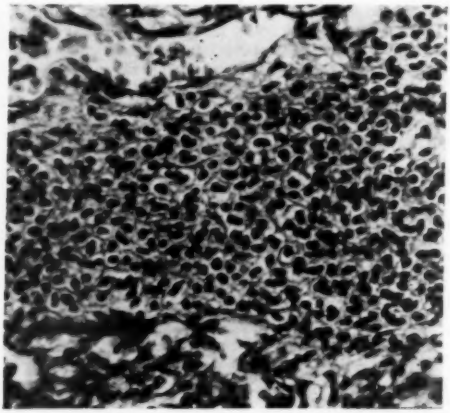

FIG. VI. Photomicrograph of portion of the tumour showing a mass of epithelial cells, closely packed together, with a squamoid differentiation. (x 350)

Several noteworthy features of this case are listed as follows:—

1. The malar bone if an unusual site for a basal cell tumour of bone (so called "adamantinoma") is another bone which is not far removed from an epithelial surface.
2. The early age of onset, 11 years.
3. A history which seems well substantiated that the lesion commenced in superficial tissues.
4. The pitfalls of treatment based on inconclusive diagnosis. A properly executed biopsy would have soon confirmed the correct diagnosis.
5. The apparent cure after four years to date and the standard of restoration.

AN ADENOMATOID TUMOUR OF THE EPIDIDYMIS

By Douglas B. Duffy
Royal Melbourne Hospital

TUMOURS of the epididymis, although reported with greater frequency in recent years, are still rare tumours whose interesting and unusual structure has led to different opinions regarding their histogenesis. The pathological classification of these tumours is confused probably because their rarity inevitably makes anyone's personal experience of them small. Thus, it is considered worth while reporting this case.

Case Report

J.L., aged 54, had noticed a hard lump on the left testicle for five or six years. He thought it had become slightly larger during that time. He complained of no other symptoms.

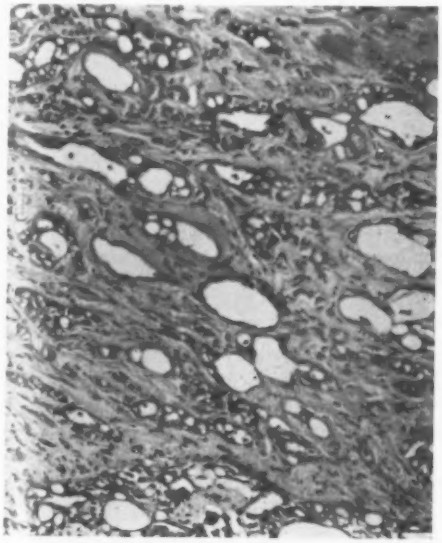

FIG. I. Photomicrograph of a section of the tumour showing spaces lined by flattened cells. (x 100)

On examination, a firm, round nodule, 1.5 cms. in diameter, was palpable in the lower pole of the left epididymis. The lump was mobile, not fixed to the testicle and was not translucent. The right testicle and epididymis were normal. Excision was advised and performed through a scrotal incision. A solid encapsulated tumour, together with portion of the lower pole of the epididymis, was removed. Convalescence was uneventful.

Pathology

The tumour was a solid, encapsulated nodule 1.5 cms. in diameter, situated within the substance of the epididymis. It was of firm consistency and the cut surface was white in colour, showing a whorled appearance.

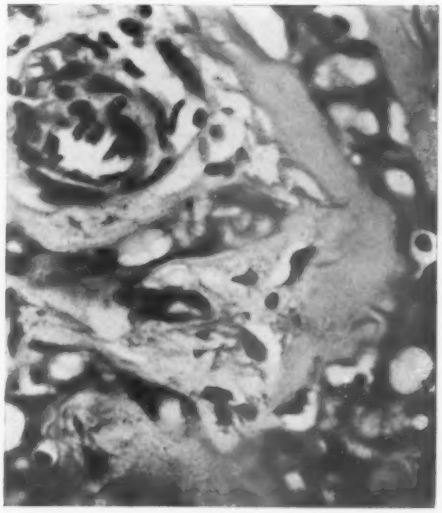

FIG. II. Photomicrograph of a section of the tumour showing the character of the cells, their spindle shaped nuclei and clear spaces in the protoplasm. (x 500)

Microscopically there was seen to be a well-defined capsule of smooth muscle. The structure of the tumour was variable, but two distinct patterns dominated the sections taken. In parts the tumour was composed of numerous gland-like spaces lined by flattened cells containing a spindle shaped

nucleus (Fig. I). Some of the cells had a vacuolated appearance (Fig. II). The spaces contained no material stained by haematoxylin and eosin. Between these spaces was a dense hyalinized acellular fibrous tissue with, here and there, an accumulation of lymphocytes.

The other pattern seen showed large areas composed of masses and cords of vacuolated cells, the individual cells having a signet ring appearance (Fig. III). These cells varied greatly in size with comparable variation of nuclei but there were few mitoses. In these areas the fibrous stroma was less apparent.

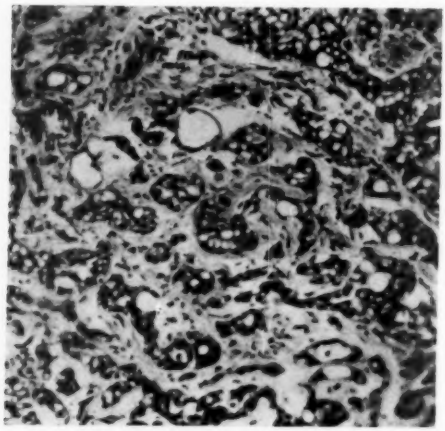

FIG. III. Photomicrograph of a section of the tumour which is composed of cords of cells. These range from a spindle to spheroidal form and contain droplets of secretion. (x 100)

DISCUSSION

Malignant tumours are stated to constitute 60 per cent. of all epididymal neoplasms and of the malignant tumours carcinoma forms 75 per cent. and sarcoma 25 per cent. (Thompson, 1936).

Of the benign tumours, myoma were formerly considered to be the most common but of recent years "adenomatoid" tumours have been reported with such frequency that there is little doubt that they constitute the majority of benign growths in this region.

From a study of the literature it is soon apparent that these "adenomatoid" tumours have been assigned a variety of names by different authors, the name usually depending on the presumed histogenesis of the tumour.

Thompson (1936), in a review of tumours of the spermatic cord, epididymis and testicular tunics, described three cases which he referred to as Grade 1 adenocarcinomata of the epididymis. These are identical with, and are now considered to be, "adenomatoid" tumours.

Gordon-Taylor and Ommaney-Davis (1942) described a similar tumour as did Blumer and Edwards (1942), the latter authors regarding it as an adenoma arising from the epithelium of the epididymis.

Golden and Ash (1945) discussed fifteen "adenomatoid" tumours of the genital tract, thirteen of which were associated with the epididymis or tunica vaginalis and two with the fallopian tube. All these tumours had a structure similar to that described in the present case report and they concluded they were benign tumours of epithelial origin.

Glaser (1950) reported two similar cases and attempted a classification of epididymal neoplasms. He followed Newton Evans (1943) and classified these tumours as mesotheliomata arising from the mesothelium of the tunica vaginalis.

Lee, Dockerty, Thompson and Waugh (1950), again reviewing the Mayo Clinic material, reclassified tumours previously reported as low grade adenocarcinomata, haemangiomata and lymphangiomata as mesotheliomata. Wyatt and Khoo (1950) recorded two cases and reviewed evidence for the origin of these tumours from epithelium, endothelium, mesothelium and mesonephric remnants.

Thus it is seen that although these tumours possess a distinct histological appearance their exact nature is as yet not established. They occur in association with the genital tract of both male and female but the

majority occur in relation to the epididymis and tunica vaginalis.

At the present time it is considered that because most suggested terms depend on an unestablished and hypothetical histogenesis the non-specific term, "adenomatoid tumour," should be retained.

The observation that they are benign tumours is supported by the microscopic appearance and clinical behaviour.

Treatment should be by local excision of the tumour.

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CONGENITAL CYSTIC DILATATION OF THE COMMON BILE DUCT

A CASE OCCURRING IN INFANCY

By PHILIP WRIGHTSON

Wellington

THOUGH congenital cystic dilatation of the common bile duct is a rare condition, it has engendered a considerable body of literature. The present writer's reason for adding to it is that the case to be reported raises some points of interest in the aetiology and treatment of the condition and of the diagnosis of abdominal tumours in infants.

CASE REPORT

Family history. The baby was the first child of his mother, who was aged 25. The mother and several brothers and sisters had severe feeding troubles in the first months of life, all being in hospital for a period. The exact nature of this trouble could not be determined; no operations had been performed.

Delivery. Full term normal delivery. Birth weight, 7 lbs. Cried, breathed and sucked well. No cyanosis in immediate post-natal period.

Progress. He took breast feeds well until the third day. He then began to vomit after almost every feed, a gentle regurgitation of most of the feed two or three minutes after it finished. There were short periods of cyanosis during the vomiting.

Findings on admission to hospital. He was admitted to hospital on his fifth day. He weighed 6 lbs. 12 ozs. The cry was weak. There was slight cyanosis and no jaundice. There was no dehydration. The cardiovascular and respiratory systems appeared normal and there were no abdominal masses. There were no abnormal signs in the central nervous system.

Progress in hospital. Oxygen was administered and the infant fed from the bottle. This was continued until the tenth day. He was then vomiting at the most once a day. On one occasion the vomit had contained a little bright blood. Cyanosis was no longer evident and oxygen was discontinued.

From the tenth to the twenty-fifth day he continued to take his feeds fairly well, vomiting a small amount once or twice a day. In several examinations his stools showed no unsplit fat globules and many fatty acid crystals in the acetic acid preparations. Gregerson's test for occult blood was weakly positive. His weight fell to 6 lbs. 8 ozs. Clinical examination remained essentially negative. At this stage no definite diagnosis could be made.

Between the twenty-fifth and thirtieth days his condition deteriorated. He became lethargic, took feeds badly, vomited after most of them and showed signs of dehydration. On the thirtieth day it was first suggested that his abdomen was distended.

Appearance when abdominal signs fully developed. He was first seen by the present writer on the thirty-fourth day. He was then a very sick, lethargic baby with lax skin and little subcutaneous fat. His cry was weak and he moved feebly. Respiration was laboured, but the alae nasi were still. His colour was greyish, but there was no true cyanosis. The anterior fontanelle was slightly sunken. The abdomen was grossly distended and the umbilicus stretched from side to side. Over the lower abdomen the subcutaneous veins were conspicuous. There was dullness to percussion everywhere except in the left lower quadrant. The extent of the dullness did not alter with position. The right side of the abdomen appeared to contain a large mass; the abdominal wall was tense and the outlines of the mass could not be made out. Rectal examination revealed no abnormality.

Radiological findings. Plain radiograph of the abdomen was reported on as follows (Dr. E. P. Allen): "The upper abdomen is filled with a very large homogeneous soft tissue mass, which is displacing the diaphragm upwards and the bowel downwards, and which is giving rise to very gross widening of the spaces between the lower ribs. The appearances are suggestive of a very gross enlargement of the liver."

The most likely diagnosis was thought to be hepatic secondaries from a neuroblastoma. A needle biopsy was decided upon.

Operation. Biopsy was undertaken on the thirty-fifth day. Under local anaesthetic a fine cannula was entered in the mid-axillary line just below the right costal margin. In advancing it, a sudden lack of resistance showed that it has entered a cavity, and, on withdrawing the trocar, bile flowed out; 170 cc. were allowed to drain slowly and the cannula was removed. As the fluid was withdrawn, the infant's general condition improved in a remarkable way. His breathing became normal and his colour, which had been a dirty grey, became pink.

The diagnosis of cystic dilatation of the bile duct was made at this stage; because of the danger of leakage of bile from the puncture, immediate operation was thought advisable.

A polythene cannula was inserted into the saphenous vein at the ankle and a slow blood drip begun.

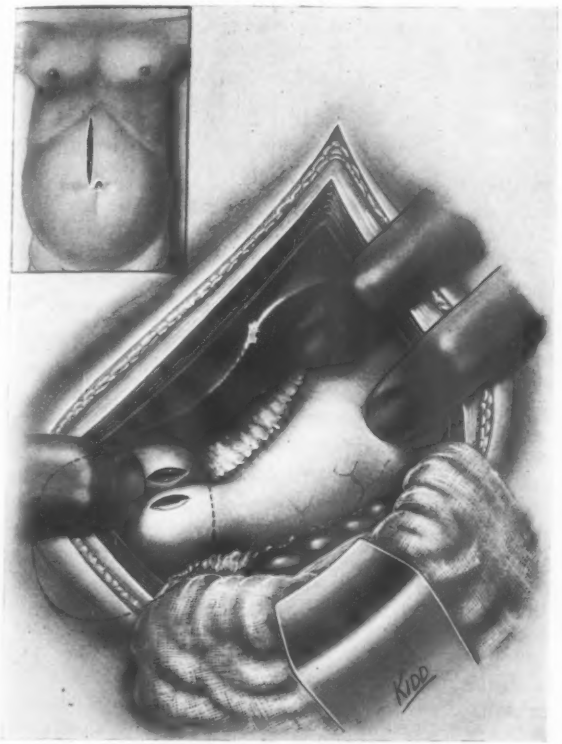

FIG. I. The condition as found at operation. The cyst is outlined and the site of anastomosis shown. Inset: The appearance of the abdomen and the incision.

A right supra-umbilical paramedian incision was made after infiltration with local anaesthetic. As the peritoneum was opened, light ether anaesthesia by open drop was begun. Exposure was good. A large cystic swelling was felt and partly seen in the position of the common bile duct (Fig. I). Its anterior wall was firmly adherent to the superior border of the first part of the duodenum. It bulged laterally into the loin and appeared to obliterate the pouch of Rutherford Morison. The gall-bladder was present and small, lying to the outer side of the cyst, with the duct apparently entering its posterior surface. The upper surface of the cyst was applied to the liver and the hepatic ducts were not visible and not sought. The stomach, duodenum and transverse colon appeared normal and, as far as could be seen without evisceration, there were no anomalies of rotation of the intestines.

The cyst was anastomosed to the first part of the duodenum. Transverse incisions were made in the adjacent parts of the cyst and the superior surface of the duodenum and the anastomosis made with two layers of suture. The wall of the cyst was about as thick as the wall of the duodenum and held sutures well. The interior of the cyst was not explored, nor was an attempt made to pass a probe down into the duodenum; it was thought that speed and avoidance of bile spillage were the paramount necessities. The point of puncture of the cannula was not seen; as there was no free bile in the peritoneal cavity it was assumed that it had sealed and would not leak when pressure had been relieved by the anastomosis.

The wound was closed with interrupted silk sutures. The whole procedure occupied fifty minutes. When the child returned to the ward he was moderately shocked, but he recovered well after two or three hours.

Post-operative period. Intravenous fluid was continued for twenty-four hours. He began to take feeds after twelve hours. He was hungry, but vomited a small amount after each feed. Bowel sounds were present after twenty-four hours and a motion containing dark blood was passed after thirty-six hours. The wound was well healed on the eighth day. It was thought that he had recovered well from the operative insult.

There followed a period of about six weeks in which, for no obvious reason, he failed to thrive. His weight fell to 6 lbs. 4 ozs., and his haemoglobin to 7.75 gm. per cent. He took his feeds hungrily, but once or twice a day would vomit about half of the amount shortly afterwards. There seemed no doubt that the anastomosis was patent, as there was bile in the vomit and no recurrence of the tumour. Fat digestion seemed normal for an infant of his age. Gregerson's test for occult blood was strongly positive, and this suggested that there might be ulceration at the site of the anastomosis with enough sepsis and loss of blood to retard his progress. Fortunately, in his thirteenth week, he suddenly began to improve. He became extremely hungry and stopped vomiting. He gained 10 ozs. during the first week and maintained this gain subsequently. By the 16th week he weighed 9 lbs. 4 ozs. and his haemoglobin was 13 gm. per cent. He had lost his wizened, fretful appearance and looked like a healthy baby.

Review at the age of one year. He appeared to be a healthy and active child and weighed 22 lbs. He had been difficult to feed and still vomited a small amount of most feeds. There had been no

suggestion of jaundice or biliary infection. Blood investigation showed haemoglobin 10.8 gm. per cent., R.b.c. 3.4 million, M.C.H. 32. Faeces showed neutral fats present in normal amounts and occasional soap plaques. Three attempts were made to obtain a successful cholecystogram, but in none could the gall-bladder be outlined.

A letter from his mother three months after these investigations said that he had ceased to vomit and was continuing to progress well.

DISCUSSION

The interest of this case lies in its relation to the theories of aetiology, to the diagnosis of abdominal tumours in infants and to the choice of operative treatment. It will be discussed under these headings. A general account of congenital cystic dilatation of the common bile duct will not be given, as full reviews are to be found in this and other journals (Poate, 1941; Walton, 1939; Zinninger and Cash, 1932; Shallow, Eger and Wagner, 1943) and in standard textbooks (Maingot, 1948; Ladd and Gross, 1941).

Theories of aetiology

There is substantial agreement that the origin of the condition lies in a developmental error. The age incidence is very suggestive. Cases are mostly seen in the first three decades and may occur very early in life. Heiliger (1910) described a typical dilatation in an almost mature foetus, in the present case the cyst became a gross abdominal tumour by the age of one month and Walton reports the post-mortem findings in a child of five weeks.

It has been suggested that growth has been disturbed either at the stage of first appearance of the bile duct anlage or at the stage of the recanalisation of the ducts. There is a disturbance of the rates of epithelial proliferation and one segment of the duct grows to a greater diameter than its neighbours. The rest of the duct develops normally, though it is possible that the narrowing of the distal part of the duct described by some authors may be due to a process of the same nature operating in the reverse way to produce a diminution of calibre (Yotuyanagi, 1936).

This theory explains satisfactorily most of the pathological findings. Some cases present in the simplest form. There is cystic dilatation of the upper part of the common bile duct, the common hepatic duct and sometimes the right and left hepatic ducts. The lower part of the common bile duct is either perfectly normal or reduced in diameter; if it is stenosed, there is, however, no complete obstruction to the flow of bile (Zinninger and Cash, 1932). The junction of the bile duct with the pancreatic duct is often abnormally placed, being up to 2 cm. from the duodenum and sometimes opening into the cyst (Blocker and Williams, 1937).

It is submitted that this cystic dilatation without gross obstruction is the fundamental lesion and that other changes described are secondary. Earlier authors have found it difficult to believe that the gross dilatation sometimes seen could develop when there was no obstruction to raise the biliary pressure. It is contended here that this disbelief is unfounded and that enlargement will occur under the influence of normal biliary pressure.

The normal bile duct is intermittently distended by pressures of up to 20 cm. of bile. The elastic limit of the walls is not exceeded and the diameter returns to normal on the release of the pressure. There are two factors governing this cycle of events, the elasticity of the wall of the bile duct and the stress imposed upon it by biliary pressure. The structure of the common bile duct, consisting as it does of connective tissue with a small amount of muscle and elastic fibre, would lead one to expect that it would be only imperfectly elastic. That is to say, one would expect that after a slight stretch it would return to its former length, but that no great increase of force would be needed to stretch it permanently; for example, one might reasonably assume that a force three times as great as that which it would normally experience would be enough to stretch it permanently. Now the fore stretching the walls of the duct is proportional not only to the hydrostatic pressure but also to the diameter of the duct. If, therefore, the duct has walls of normal constitution but has attained, as a result of congenital defect, a diameter three times the normal, the material of the walls will be subject to three times the normal stress and we can expect it to be stretched permanently by physiological biliary pressures.

The situation and structure of the common bile duct make it peculiarly susceptible to this process. It lies in the edge of the lesser omentum unsupported by solid structures and in its walls it contains no elements which can be relied upon under the stress of distension to hypertrophy and resist. It is interesting that very occasionally the muscle fibres seem to answer the call. In the case described by Zinninger and Cash, the wall of the cyst was thickened by great muscular hypertrophy. The hypertrophy was thought by these authors to be due to active effort to expel the contents of the cyst, but more probably the muscle had a static rather than a dynamic function and its growth was the response to a normal biliary pressure within a duct of great diameter.

The secondary changes most frequently described are firstly the formation of a flap over the outlet of the cyst, often described as a valve and probably having some of its mechanical functions, and secondly, narrowing and kinking of the common bile duct between the cyst and the duodenum.

As the cyst grows, it is tethered by the common bile duct distally and the hepatic ducts proximally. Behind, it is supported by the vertebral column, in front by the liver above and by the abdominal wall and intestines below. Enlargement can only occur downwards, forwards and to the right. The weight of the contained bile acts in this direction when the patient is erect. This may be a considerable force, a cyst 6 cm. in diameter weighing about 115 gm. and one 12 cm. in diameter about 900 gm. It is easy to see how, under these forces, such a cyst may become eccentric to the line of the bile ducts and how this will produce a flap (Fig. II). That the flap does not constantly produce obstruction is evident from the clinical history of the cases in which it has been observed; in many of them jaundice was absent or intermittent only. Two explanations are possible. The first is that the valve is ineffective because of the rigidity of the flap or the arrangement of the parts. The second, suggested by Judd and Greene (1928), is that the valve is effective when the cyst is partially distended and the walls slack, but as the cyst becomes tense with the accumulation of bile, the fold is taken up into the walls, the valve is released and the sac is emptied ready for another cycle.

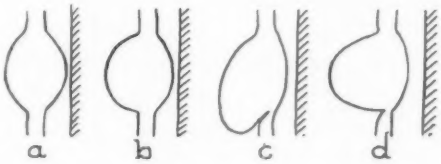

FIG. II. Diagrams to show the growth of a cyst and the formation of a valve.

(a) Early stage; the shaded line represents the unyielding structures posterior to the cyst.

(b) Later; the cyst can only enlarge downwards, forwards and to the right.

(c) A valve is formed at the outlet.

(d) As the cyst becomes tense, the valve may be taken up into the wall and cease to function.

The narrowing of the distal part of the bile duct may be of developmental origin, as suggested above, or may be secondary to traction and distortion produced by the enlargement of the cyst. The kinking which has been described probably has the same origin. In advanced cases these changes may follow inflammation.

Lastly, when a secondary obstruction has been established at the outflow from the sac, the biliary pressure rises to abnormal heights and previously normal structures suffer from distension. Jaundice and infection follow and the case presents the complications described so often in the early literature.

Abdominal tumours in early infancy

Listed below are some of the possible causes of abdominal tumour occurring in the first few months of life.

(1) Hepatic tumours. (a) Enlargement of the liver in erythroblastosis foetalis and congenital syphilis should present no difficulty in diagnosis.

(b) Ladd and Gross mention cases of haemangioma, hamartoma and secondary neuroblastoma occurring at ages of one month, eight months and eleven days respectively.

(2) Renal tumours. Wilm's tumour may occur very early in life and Ladd and Gross report a case at the age of two months. It should be possible to determine the origin of such a tumour by clinical methods.

(3) Retroperitoneal tumours. Neuroblastoma sympatheticum may present as a swelling anywhere in the retroperitoneal tissues, often on both sides; the obvious feature may be secondary deposits in the liver. Ladd and Gross describe one case at the age of four days.

(4) Intestinal tumours. Duplications may present in the first weeks of life, but generally obstruction rather than tumour is the dominant symptom. Ladd and Gross describe a sigmoid duplication measuring 12 x 10 x 8 cm. in an infant of two weeks and a duodenal duplication measuring 4.5 x 3.5 x 3.5 cm. at five weeks, so presumably this condition could enter into the differential diagnosis.

(5) Biliary tract tumours. The case just reported shows that cystic dilatation of the common bile duct must be considered in the diagnosis. The mass may be the sole symptom, or, as in the case reported by Walton at this age, there may be jaundice and the signs of inflammation.

Recent advances in technique have made it justifiable to attempt to treat babies with some of these conditions and accurate diagnosis becomes most desirable. In this case, the diagnosis was thought to be hepatic secondaries from a neuroblastoma, and the real condition was not considered. The tumour was so large and the infant's condition so poor that it seemed certain that if the condition was in fact neoplastic no treatment would be justifiable. In these circumstances it seemed proper to attempt to confirm this gloomy prognosis by needle biopsy of the mass.

Fortunately, the correct diagnosis was revealed and no harm was done. In circumstances other than these it would not appear to be a proper procedure, being liable to provoke uncontrollable bleeding if the tumour should be neoplastic or leakage if cystic. Surgical exploration would seem to be the only proper procedure to arrive at a diagnosis in a doubtful case.

Considerations in treatment

Treatment demands an anastomosis of the biliary and intestinal tracts and the danger of infection of the bile ducts and liver must always be borne in mind. The patients are seen in their early decades and the precautions that are taken must be effective throughout the accidents of many years of life.

The standard treatment has been to anastomose the cyst to the duodenum. Obstruction at the outflow from the cyst is relieved and the sphincter of Oddi is bypassed. The pressure within the cyst can therefore never rise more than a very little above the neighbouring intra-abdominal pressure and no distension of the cyst can occur. The obvious disadvantage of this arrangement is that infective matter may enter the flaccid walled cavity of the collapsed cyst, stagnate there and lead to inflammation. Dickson Wright (1936) thought this danger so great that he advised against operation except when biliary obstruction had occurred; then, he recommended, the cyst should be excised and the upper and lower ends of the bile ducts reconstituted over a T-tube. Walton (1939), on the other hand, found no ill effects to follow this operation. Ladd and Gross (1941) studied 5 children over periods of nineteen, sixteen, fourteen, eleven and six years after operation. Four were well with excellent physical development and no biliary disease; the fifth suffered from recurrent cholangitis and jaundice and it was thought that the anastomosis, which had been made with a Murphy's button, was too large.

In spite of these favourable results, it would appear to be desirable to excise the cyst, if it can be done without undue risk. Shallow, Eger and Wagner (1943) state that this has been done on eight occasions, with five successes, and a further case was reported in 1946 (McLaughlin, 1946). In all these cases the biliary tract was reformed with a hepatico-duodenostomy, so that the danger of infection would not seem to have

been reduced to the minimum. McWhorter (1939) describes the autopsy findings in one of these patients, who had had a hepaticoduodenostomy done thirteen years before. At the time of operation there had been gross dilatation of the large intrahepatic bile ducts and post-operative barium meals had shown free reflux of opaque material into the dilated ducts. In spite of this, there was no evidence, either clinical or histological, of cholangitis. This danger, therefore, does not seem to be very great.

The greatest refinement of technique would probably be to excise the cyst and anastomose the hepatic ducts to a Y-limb of jejunum. The second choice of operation, to be used when excision of the cyst was inadvisable, might be to anastomose such a limb of jejunum to the cyst. These suggestions may well be only counsels of perfection and it will probably always remain a simple and acceptable course to perform the direct anastomosis of cyst to duodenum, an operation which, though not perfect, seems on the whole to be satisfactory.

SUMMARY

1. A case is described of congenital cystic dilatation of the common bile duct; the condition was discovered and treated successfully at the age of five weeks.

2. The aetiology and treatment of the condition are discussed and some observations are made on the diagnosis of abdominal tumours in infants.

ACKNOWLEDGEMENTS

This case was treated in the New Plymouth Hospital, N.Z., and I am greatly indebted to Miss Jean Sandel, Dr. E. P. Allen and Dr. D. Allen for surgical, radiological and pathological advice, to Sister Vickery for her care of the patient, and to Dr. A. M. Veale for providing me with details of the infant's progress.

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TREATMENT OF INTERNAL HAEMORRHOIDS

By E. S. R. Hughes
Melbourne

ALTHOUGH haemorrhoids are rarely fatal in themselves they can be responsible for much discomfort, and occasionally force the sufferer to bed. Many such patients have had friends who have been victims of faulty treatment, and this has persuaded them against any form of surgical treatment; they resort to lay-press advertisements with little hope of any permanent cure. The practitioner is in the happy position, however, of being able to urge the patient to accept surgical treatment, with the prospect of a permanently good result. Few surgical conditions are more amenable to treatment than are haemorrhoids. If the surgeon fully understands the nature of the condition, can recognize the degree of severity of the individual case, and can definitely exclude the presence of a carcinoma, he should be in the position to cure nearly every case.

Internal haemorrhoids are characterized by a redundancy of the mucous membrane of the anal canal above the anal intermuscular septum. They are the most common cause of bleeding from the rectum, and sometimes are responsible for severe blood loss. For this reason they have been regarded as primarily vascular in origin.

Surgical Anatomy of Internal Haemorroids

The mucosa of the anal canal, lined by cuboidal and columnar epithelium, secretes mucous and normally is possessed with some redundancy. When this redundancy becomes excessive internal haemorrhoids will be the result. The redundant, prolapsing mucosa is not arranged haphazardly.

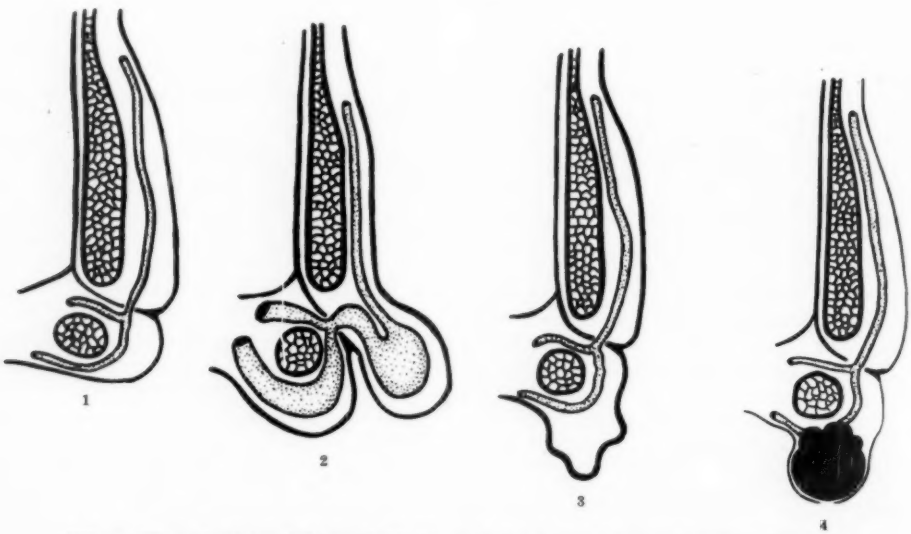

FIG. I. When the internal haemorrhoid (1) prolapses the peri-anal skin becomes distended because of the venous congestion (2); eventually the peri-anal skin becomes unduly redundant and forms a skin tag or one type of external pile (3); if, as a result of straining, one of the thin walled veins in the peri-anal space should rupture, a painful peri-anal haematoma is the result (4).

There are three main or primary haemorrhoids, a right anterior, right posterior, and left lateral. Smaller secondary haemorrhoids also occur; the most common one to be identified is found in the midline posteriorly. The reason for this orderly arrangement of the haemorrhoidal zone is not certain. The tributaries of the superior haemorrhoidal vein have their origin in the anal canal, and gather as a plexus in the submucosa of the anal canal; some believe these vessels become arranged into three main groups as they course upwards. These groups are said to correspond to the haemorrhoidal redundancy of the mucosa of the anal canal. It is the enlargement and engorgement of these veins which is the cause of haemorrhoids. Others point out that there is evidence to show that the taenial thickenings of the longitudinal coat of the colon persist into the rectum; between the taeniae the bowel is not well supported at the anal intermuscular septum so allowing the mucosa to prolapse in the form of the three haemorrhoids.

FIG. II. Prolapsed third degree haemorrhoids. The groove between the peri-anal skin and internal haemorrhoids has been accentuated by the oedema.

The veins within the haemorrhoids anastomose freely with the peri-anal venous plexus. Engorgement of the haemorrhoidal plexus is associated with similar engorgement of the peri-anal veins. Repeated episodes of such congestion soon result in redundancy of the anal and peri-anal skin (Fig. I). When the internal haemorrhoids are prolapsed it is possible to see a groove on the surface of the haemorrhoid; above the groove is the reddish mucosa of the internal haemorrhoid, whilst below is the pigmented skin of the anus (Fig. II).

SURGICAL PATHOLOGY

There are three degrees of haemorrhoids (Fig. III).

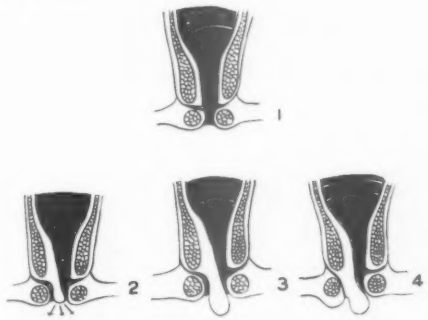

FIG. III. Three degrees of prolapse of internal haemorrhoids are recognized. In first degree haemorrhoids it is so slight that the patient is often not aware of the fact, but bleeding calls his attention to the abnormality (2); in second degree haemorrhoids the prolapse is sufficiently great to be recognized by the patient but it returns spontaneously (3); whilst in third degree haemorrhoids the prolapse does not return without assistance and this might be due to the elongation of the longitudinal muscle coat (4).

First degree

The mucosa prolapses just sufficiently to be caught by the closing subcutaneous sphincter. Arterial blood continues to enter the haemorrhoid but the venous return is obstructed. The veins distend, rupture, as does the overlying mucosa, and haemorrhage occurs. This might be quite severe, with blood streaming into the closet, but it stops as soon as the haemorrhoid returns, and this it does spontaneously. The patient is often unaware that there is any prolapse; haemorrhage draws his attention to the condition.

Second degree

If the mucosa prolapses further, the patient becomes conscious of the protrusion, but it usually returns spontaneously after the bowel action is completed. The subcutaneous sphincter may, however, prevent the return to the anal canal. The veins within

the haemorrhoid become traumatized and thrombose. Thrombosed internal haemorrhoids project beyond the anal verge; they are associated with oedema of the related part of the peri-anal space.

Third degree

In long standing haemorrhoids, the subcutaneous sphincter relaxes; the internal haemorrhoid is chronically prolapsed. The haemorrhoids can be pushed back into place manually but they reappear on the slightest effort. The longitudinal muscle inserting into the anal intermuscular septum appears as though it has become elongated through the persistent prolapse, preventing it from exerting any retentive pull on the mucosa.

DIAGNOSIS OF HAEMORRHOIDS

Proctoscopy enables an accurate diagnosis of haemorrhoids as well as the degree of prolapse. The proctoscope is inserted its full length, the obturator removed; the proctoscope itself is then gradually withdrawn. The mucosa at the ano-rectal ring falls into the mouth of the proctoscope but normally on reaching the anal intermuscular septum the anal mucosa shows no tendency to prolapse. In first degree haemorrhoids, the mucosa can be seen to prolapse past this level, is held for a few seconds by the subcutaneous sphincter, and may sometimes become congested and plum coloured, and occasionally the vessels and mucosa rupture to give a sharp haemorrhage with blood spurting away from the anus. Second degree haemorrhoids prolapse further, and remain outside; but they return when the patient changes position. Third degree haemorrhoids require manual replacement; they can be pushed back, tend to prolapse again and to remain chronically prolapsed.

The majority of patients are apprehensive as to the possibility of cancer being the cause of the trouble. It behoves the surgeon to give positive reassurance to the patient that there is no malignancy responsible for his symptoms. This reassurance can only be given if routine sigmoidoscopy be included in every ano-rectal examination. There is no evidence to show that haemorrhoids represent a symptom of carcinoma of the rectum; but bleeding is common to both conditions, and a patient with haemorrhoids may have a carcinoma, unsuspected until discovered with the sigmoidoscope.

TREATMENT

Not all patients with haemorrhoids require treatment; some, on learning that the bleeding is caused by haemorrhoids and not by cancer, are satisfied and desire no treatment.

Haemorrhoids are common in pregnancy, but active treatment is rarely required. The situation should be explained to the patient, the bowels should be regulated and, if necessary, lubricated with paraffin oil.

Active treatment should not be denied to the elderly or otherwise infirm; but should such treatment be declined, similar advice may help.

INJECTION TREATMENT

When haemorrhoids are injected, the solutions are placed in the interstitial tissue of the submucosa, and not into the veins of the haemorrhoids. Such injections cause a degree of fibrosis within the submucosa which result in adherence of the mucosa to the muscularis. The degree of prolapse is lessened, at least temporarily, and especially in first and second degree haemorrhoids. Bleeding from haemorrhoids is reduced and often stopped completely; this favourable effect on bleeding is not due to thrombosis of the haemorrhoidal veins but to the interstitial fibrosis.

Selection of cases for injection treatment

(1) First degree haemorrhoids can be injected with good results in most cases.

(2) Second degree haemorrhoids are not cured by injections. Prolapse is temporarily relieved but nearly always recurs; the bleeding is stopped for long periods. A further set of injections can be given on recurrence, and in this way it is possible to tide over the patient for some years. Therefore, patients with second degree haemorrhoids should be given the option of injection if they are troubled by bleeding or if they are not desirous of, nor suitable for, operative treatment.

(3) Third degree haemorrhoids are never suitable for injection unless the patient is bleeding and there is to be some delay before operation. The prolapse is not noticeably improved by injection.

The injection syringe

The injections are done with a 10 cc. syringe, fitted with a locking needle. The needle must lock because considerable force is required to push the viscid fluid down the needle; if the joint is not strong the solution will leak.

The injection needle should be 10 cm. in length; it can be straight or curved, although the former is easier to manipulate and to control. The average proctoscope has a tubular portion about 6-7 cm. long; but the needle must be longer than this to keep the syringe away from the mouth of the proctoscope so that the clinician can keep the end of the needle under constant observation. The needle should have some marking device (like ureteric catheters) at its lower end so that the surgeon can estimate at a glance just how deep the needle has penetrated. The needle of the Gabriel syringe has an outer sheath which terminates about 1.5 cm. from the bevel of the needle. This sheath does not prevent the needle from perforating the anal canal; it should be used as an identification mark rather than a shield.

The injected solution

The most widely used solution is 5 per cent. phenol in almond or peanut oil. It is non-toxic to the body and harmless locally; it appears to cause a satisfactory interstitial fibrosis, but with minimal necrosis of tissues. Large amounts can be injected locally; up to 10 cc. can be pushed into the one haemorrhoidal zone without danger, and all three haemorrhoids can receive the same amount at the one visit with little discomfort to the patient. The usual regime is to use one 10 cc. syringeful; 4 cc. are placed into the left lateral haemorrhoid, 3 cc. into the right anterior, and 3 cc. into the right posterior.

Technique

The patient is placed into the left lateral position. The proctoscope, fitted with a good light, is passed, the obturator removed and the ano-rectal ring identified by sliding the proctoscope up and down within the anal canal and lower third of the rectum. The ano-rectal ring closes in on the mouth of the proctoscope; just below this ano-rectal level, the upper ends of the three primary haemorrhoids can be identified and this represents the site for injection (Fig. IV).

FIG. IV. The injection treatment of haemorrhoids. The proctoscope is inserted; (1) the obturator is removed; (2) then the proctoscope is gradually withdrawn until the mucosa of the ano-rectal ring falls into the mouth of the instrument; (3) this is the site for the injection.

Obstructing faecal material is pushed away with a pair of forceps; if the faecal material be liquid, a cotton wool swab is pushed into the lower third of the rectum and is left there. No attempt is made to sterilize the overlying mucosa.

The syringe is held in the right hand, and the needle is passed down the proctoscope. The end of the needle is brought to lie on the mucosa, just distal to the distal end of the proctoscope. The point is then gently thrust through the mucosa into the submucosa, at a site corresponding to the left lateral haemorrhoid (Fig. V). About 4 cc. are injected; as the injection is made the proctoscope is withdrawn slightly so that the solution can diffuse through the anal canal submucosa. The fluid should pass down the syringe needle comfortably even though a firm, steady pressure is necessary; if undue force is required the needle is probably in the wrong place; whilst if the fluid runs in too easily the locking mechanism has come adrift, or the point of the needle has penetrated a fold of mucous membrane so that it re-enters the anal canal or rectum.

The needle is moved to the right anterior zone; 3 cc. are injected into the submucosa at this level. Particular care should be used in injecting the right anterior haemorrhoid because the point of the needle will be close to the urethra in the male and vagina in the female. The remainder of the solution in the syringe is injected into the submucosa of the right posterior haemorrhoid.

FIG. V. The proctoscope is tilted slightly. The needle is passed down the lumen of the instrument and the point brought to lie on the mucosa at the level of the ano-rectal ring. The needle is thrust into the submucosa and the injection made.

The proctoscope is removed; any oil leaking on to the peri-anal skin is swabbed away and the patient allowed to get up off the couch; after an hour or two, the oil tends to gravitate down to the level of the anal intermuscular septum causing some soreness in the anal canal. The actual injection is not painful but is associated with an uncomfortable feeling of distension.

The patient is advised not to defaecate on the day of the injection but to continue his normal bowel habit the next day. He is given an appointment for review in three weeks time.

The second and subsequent injections are not usually as satisfactory as the first. The injection material will not run freely as a rule; whereas 4 cc. were easily injected at the first visit, less than 1 cc. might be possible at the second; an over-enthusiastic surgeon might damage the bowel wall if he tries to repeat the volume used at the first injection.

The complications of injection treatment of haemorrhoids are:—

(1) Pain. Pain is usually conspicuous by its absence. Indeed, the patient is often surprised when told that the haemorrhoids have been injected. Some discomfort is to be expected, but severe pain indicates an error in technique. The injection has been made either too deep or too low; an injection too deep places the injection in the peri-anal or peri-rectal tissues, whilst one too low is into the sensitive area around the anal intermuscular septum. The injections should not be as low as the anal papillae, and certainly never below the anal intermuscular septum.

(2) Haemorrhage. The point of the needle sometimes punctures a branch of the superior haemorrhoidal artery. When the needle is withdrawn a pulsating stream of blood issues from the puncture wound in the mucosa. The proctoscope is withdrawn and the patient re-examined in half an hour; the haemorrhage has nearly always stopped. If, on re-examination, bleeding is still in progress, the puncture wound should be cauterized.

(3) Ulceration. Sloughing at the injection site is rare when 5 per cent. phenol in almond oil is used. Stronger solutions of phenol should be used with great caution; glycerine solutions have been responsible for deep injection ulcers and should be avoided. If the 5 per cent. solution of phenol be used routinely, even injections placed inadvertently into the mucosa and raising a white avascular wheal, will not cause ulceration.

(4) Haematuria. Occasionally, a sharp haematuria follows injection of haemorrhoids. The patient is a male, and the injected haemorrhoid is the right anterior one. The haematuria is due to direct trauma of the urinary tract at prostatic level by a needle pushed too deeply. It is a serious complication because it necessitates hospitalization for several days. Treatment is symptomatic.

(5) Miscellaneous. Sensitivity to the injected agent may cause a temporary proctitis. Extensive venous thrombosis causes acute discomfort; palpation discloses lumpy induration outside the anal canal. Sometimes the injection has been held responsible for abscess formation in relation to the anal canal. Jaundice due to a transient hepatitis has been recorded.

OPERATIVE TREATMENT

A popular and very satisfactory operation for haemorrhoids is the "ligature and excision" operation. This operation, the standard procedure at St. Mark's Hospital for

Diseases of the Rectum, London, is based on surgical anatomy. The operation is designed to remove the prolapsing mucosa of the anal canal together with the corresponding redundant peri-anal skin, to leave a smooth anus. The results of the operation are excellent.

Selection of cases for operative treatment

1. Second degree internal haemorrhoids are suitable, especially if the corresponding peri-anal skin presents tags.

2. Third degree internal haemorrhoids should be treated by operative means; injection treatment has little hope of anything but very temporary relief.

Pre-operative treatment

When the decision to operate is made and accepted, the patient is given a supply of an intestinal sulphonamide. If succinyl-sulphathiazole be prescribed, 10 gm. daily, in four divided doses, is advised for the five days preceding the operation. Such premedication reduces the flora within the anal canal, minimizing the severity of wound infection post-operatively.

Admission is arranged for the day preceding operation. No aperients, no enemata and no bowel washouts are necessary; the patient may have a bowel action a short while preceding the operation. No restrictions are placed on the diet. The perineum is shaved, but it is quite unnecessary to remove the supra-pubic hair.

Anaesthesia

If the haemorrhoids are a source of great discomfort to the patient, yet general physical factors contra-indicate operation under general anaesthesia, the surgeon can safely advise surgery under local anaesthesia. But most patients are suitable for general anaesthesia. The anaesthetic of choice is a continuous thiopentone supplemented by minimal doses of relaxant. Induction and recovery from the anaesthetic is smooth. There is no straining or coughing during the anaesthetic and no risk of laryngeal spasm. In the average adult male or female, 2.5 per cent. thiopentone is used with 40 mgm. "Flaxedil" mixed in with each half gramme of thiopentone. The dosage of "Flaxedil" may be slightly increased or decreased depending upon the build and age of the patient. Respiration is, if at all, only slightly depressed and it does not need to be manually assisted. The patient is not intubated but all facilities for intubating are on hand and ready should they be necessary.

The technique of the ligature and excision operation

The patient is placed in the lithotomy position. The legs should not be slung outside the poles if such are used to maintain this position. If the legs lie outside there is a tendency for undue pressure on the calf of the leg which is not completely prevented by padding.

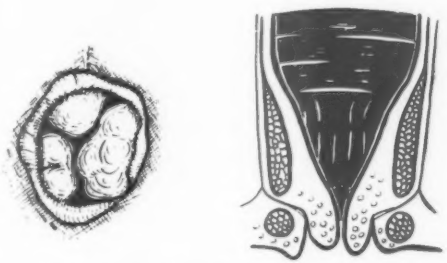

FIG. VIa. Internal haemorrhoids projecting through the anal verge.

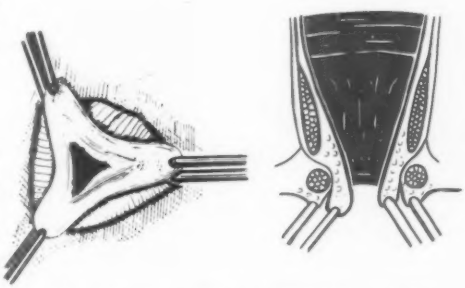

FIG. VIb. The internal haemorrhoid and the corresponding peri-anal skin are grasped with artery forceps and gently retracted; Milligan's triangle of exposure is outlined by rectal mucosa.

A pair of straight artery forceps grasps the peri-anal skin opposite each of the three internal haemorrhoids, in the left lateral, right anterior and right posterior segments. Traction on these forceps opens the anal orifice, and brings into view the lower end of the corresponding internal haemorrhoid. The forceps are given to assistants to hold; each should be held in a separate hand.

A pair of artery forceps (curved artery forceps are conveniently used so as to enable rapid distinction from the first, straight, or peri-anal forceps) firmly bites the mucosal fold representing the primary haemorrhoid. Each is secured in turn, and by gently pulling downwards and outwards on each of these forceps the pink rectal mucosa is brought into view; it is in the form of a triangle, Milligan's triangle of exposure. Both the peri-anal (straight) and the haemorrhoidal (curved) forceps may require some re-adjustment before the exposure is satisfactory (Fig. VI a and b).

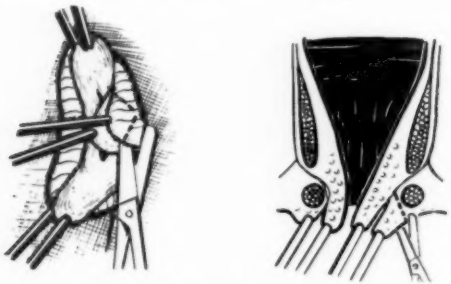

FIG. VIc. A "V" shaped cut is made with the scissors, one blade of which is placed in the groove leading to the anal intermuscular septum.

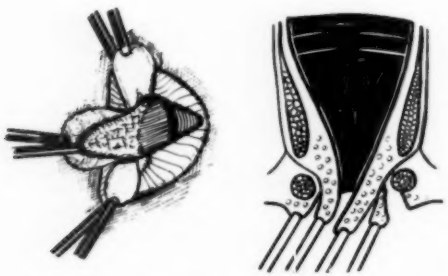

FIG. VId. The circular subcutaneous muscle sphincter is exposed and medial to this muscle is the well defined longitudinal muscle passing to the mucosa.

The left lateral haemorrhoid is first ligated. The two forceps, the peri-anal and haemorrhoidal, attached to the left lateral haemorrhoid are both held in the surgeon's left hand; they are held in such a way as to permit identification of the subcutaneous portion of the external sphincter, a constant landmark in the operation, by the index finger of the same hand. The scissors, held in the right hand, are poised with one blade in the groove between the internal haemorrhoid and peri-anal skin, and the other blade on the surface of the peri-anal skin. The scissors cut through the skin and the corrugator ani. A second cut, similar to the first, is made above it and so directed as to meet the first cut at a "V" shaped junction. The triangular flap of peri-anal skin is dissected off the underlying sphincter by deliberate sharp dissection with the scissors. Traction on the peri-anal straight artery forceps aids this dissection. The subcutaneous part of the external sphincter is exposed. This muscle is well defined; at the inner edge of this muscle is a smooth, pale but well defined sheet of tissues with fibres arranged in a longitudinal direction. This is the longitudinal muscle and its extension, the anal intermuscular septum, which is attached to the mucosa. The dissection is now completed. The mucosa of the anal canal is not stripped off the underlying sphincter, because the dissection stops at the anal intermuscular septum (Fig. VI c and d).

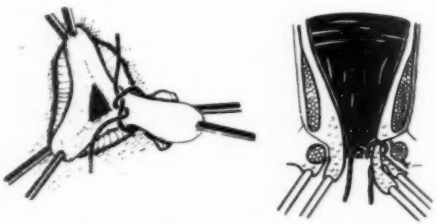

FIG. VIe. A ligature is placed around the internal haemorrhoid, and includes the anal intermuscular septum and the peri-anal skin flap.

A ligature is placed around the haemorrhoid. Traction on the haemorrhoidal (curved) forceps brings the mucosa well down. The ligature fits into a groove at the base of the peri-anal skin flap and, when tied, it includes the peri-anal skin, the anal mucosa, and the anal intermuscular septum. Inclusion of the latter prevents the upward retraction of the ligated pedicle when the forceps are removed. The ligature material should be strong because the penalty of an insecure tie is serious. Some surgeons prefer stout silk; the author routinely uses chromic catgut (No. 2), with the knot on the lumen (Fig. VI e).

The amount of bleeding from the peri-anal skin cut is variable; some patients require no haemostasis other than pressure, but sometimes up to half a dozen ligatures may be necessary in each pile area.

After the left lateral haemorrhoid has been ligated, the ligature is left long and is given to an assistant to hold in a pair of artery forceps. The assistant should continue to keep traction on the ligature so as to maintain exposure. The right posterior haemorrhoid is the second to be ligated; if the right anterior should precede it, blood may trickle down and interfere with exposure of the operative field. The surgeon must watch intently the skin bridges between the skin cuts; carelessness will cause stenosis at the anal margin (Fig. VI f).

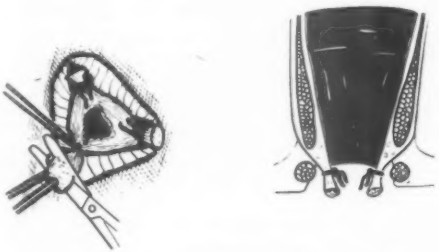

FIG. VIf. After each haemorrhoid has been ligated that part distal to the ligature is removed. The stumps remain outside until pushed back.

After each of the haemorrhoids have been ligated, that part of the mass distal to the ligature is excised. The ligatured stumps are pushed back into the anal canal to leave three skin wounds; the ligatures are cut short because if left long the ends project outside the anus and are responsible for post-operative irritation. The skin wounds are trimmed with a pair of fine scissors so that any potential oedematous skin tags are removed (Fig. VI g). This is an important step because the final objective of the operation is a smooth anus as well as a normal anal canal.

Applied carefully, the initial dressing prevents undue soiling of bed linen and it exerts some pressure on the skin bridges, preventing the accumulation of blood and clot under them. Dry gauze, lubricated on a corner, can be pushed well into the anal canal; three pieces are inserted in such a way that each piece lies opposite a skin bridge, and between the ligated stumps of the haemorrhoids. No tube is left *in situ;* a tube is useful as a means of enabling the surgeon to insert the gauze dressing, but as soon as the dressings are in place the tube is removed. Vaseline gauze is not favoured; the grease irritates the skin and the open skin wounds smeared with a film of vaseline are not so healthy in appearance.

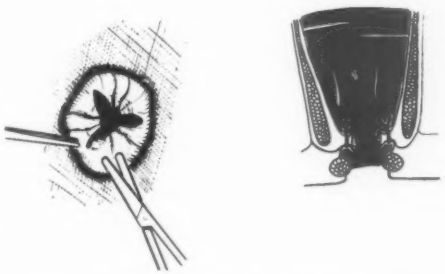

FIG. VIg. The skin cuts are trimmed to leave smooth wounds and smooth edges; if the wounds are not carefully trimmed there is a tendency to develop skin tags.

The amount of anal skin removed in this operation should be the minimum necessary to obtain a smooth anus; if the skin of the anus be normal in appearance no skin need be removed. It is unwise to suture the skin because haemostasis is rarely complete and haematoma formation is likely.

Post-operative treatment

Pain may be severe and requires morphia for relief. The patient may get out of bed when he feels like it and this usually means the next day. No restrictions are placed on diet; naturally, for a day or two after operation, the food intake is less.

The bowels may be permitted to act when the urge for defaecation arises; some patients actually have a bowel action on the day after the operation. In most cases, however, there has been no movement by the end of the second day after operation and the patient is then given an aperient to produce a motion the following day.

On the third day after operation, the patient is permitted a hot bath. He sits in the hot bath and when the gauze dressings in the anal canal are thoroughly soaked they are withdrawn by the patient himself. If the

bowels act on the morning of the third day, the gauze dressings may be already out before the patient enters the bath. Following the bath, the anal region is thoroughly dried with cotton wool; the only dressing then required is a small piece of cotton wool one corner of which is tucked into the anal canal to keep it in position. This cotton wool dressing may have to be changed three or four times during the day. It should not remain in the anus if it is soaked with exudate as it merely irritates the anal skin.

A routine is then developed for the remainder of the patient's stay in hospital. After a normal breakfast the patient has a bowel action in the toilet; a bed pan is unnecessary as the patient is quite mobile. After the bowels have opened, the patient makes no attempt to clean the anus; he proceeds to the bath, after which the anus is dried and dressed.

The patient should stay in hospital until the tenth day after operation. By this time the danger of secondary haemorrhage has largely receded. The peri-anal wounds have granulated, but are not healed; defaecation will still be accompanied by some discomfort. The only dressing the patient requires at home is cotton wool. In special circumstances the patient can go home earlier.

Some surgeons prefer the daily passage of a finger into the anal canal, commencing a day or two after the first bowel action. Such a procedure causes discomfort and, to some patients, is an unpleasant sideshow to the surgical treatment. It is unnecessary, because a daily bowel action will give sufficient dilatation if it be required, whilst an operation performed with skill leaves no treatment of this kind of any value.

The patient should be seen ten days after discharge from hospital, that is three weeks after operation; the wounds should now be nearly healed. A rectal examination will reveal a smooth anal canal, although the site of the ligated stumps can usually be recognized. The peri-anal zone should be smooth; but if skin tags be present, the surgeon need not be in any great hurry to remove them as they often disappear almost completely.

Complications of operative treatment

The ligature and excision operation, performed with care and with an understanding of surgical anatomy, is rarely attended by any serious complication. The operation, perhaps, is regarded by some as a minor procedure but it may end in a tragedy. The surgeon who operates with a gentle touch, who pays attention to the smallest detail, rarely has any complication.

(1) Haemorrhage.

Haemorrhage may be early or late in the post-operative period. Primary and reactionary haemorrhage is nearly always from the vessels in the peri-anal skin wound. When the haemorrhoidal pedicle is ligated, the assistant should remove the haemorrhoidal (curved) artery forceps as the ligature is tightened; if the tip of the forceps are included in the ligature the vessels will not be tightly secured and early severe haemorrhage from the pedicle will result. If the haemorrhage is from the peri-anal vessels the bleeding point is easily secured. If the haemorrhage is from the internal haemorrhoidal plexus, the patient should be returned to the theatre, re-anaesthetized and the pedicle re-tied.

Secondary haemorrhage is always from the internal haemorrhoidal plexus and occurs as a rule between the seventh and tenth day as the ligature sloughs off. The blood loss is often alarming; the bleeding occurs into the rectum and acts as an "auto-enema." The amount of blood lost may demand immediate resuscitation. It is difficult to secure the bleeding vessels by direct approach because the exposure is cramped and the tissues are friable. Pressure is reliable, and is applied by means of a piece of gauze wrapped around a rubber tube and inserted into the rectum through a proctoscope; the proctoscope is removed and the gauze and tube left *in situ*. Downward traction on the tube brings the gauze in firm apposition with the ano-rectal ring and the haemorrhage stops. Pre-operative administration of intestinal sulphonamide has been effective in preventing this complication.

(2) Infection.

Some infection is inevitable; an open wound in such a contaminated area must be infected to some degree. Occasionally, cases

are seen in which the wounds become indolent; four weeks after the operation there may still be little evidence that they are healing. These wounds should be cultured, and antibiotic sensitivity tests done; the cause of the slow progress is to be found in the infecting organism and not in the absence of a growth factor such as Vitamin C.

The infection might be more virulent; the wound becomes unduly painful and tender; an abscess forms and discharging results in a fistula-in-ano. It will require appropriate treatment.

(3) Stenosis.

Stenosis should never occur; but, unfortunately, it is not uncommon. The narrowed portion may be at the skin margin, or it may be within the anal canal.

Stenosis at the anal verge is due to excessive removal of skin; skin bridges are too small or even absent. As the tissues heal by secondary intention, the orifice contracts. With each bowel action the skin tears, a fissure forms from which the patient has no relief; each act of defaecation is feared and the patient prescribes himself a diet in the hope that the number of visits to the toilet can be reduced. The orifice may be grossly contracted, and a fissure-in-ano can usually be demonstrated.

Anal stenosis requires operative treatment. A wedge of tissue should be excised from the anal margin and a skin graft applied; to allow the wound to heal by granulation tissue is to invite recurrence. The results of excision and primary skin grafting in such cases are excellent.

Stenosis within the anal canal is more difficult; the narrowed segment does not involve the muscularis but is confined to the mucosa and submucosa. The orifice may be so small that a finger cannot be admitted. The mucosa of the rectum and colon above the stricture may be the seat of an ulcerative colitis, with secondary abscess and fistula formation. If the stenosis be within reach of manipulation from the anus, regular dilatation is a satisfactory palliative measure; the dilatations done with the finger or Hegar's dilators must be performed regularly and for the rest of the patient's life. In some cases, especially if the stricture be high, an excision might be attempted, with suture of the mucosa.

(4) Recurrence.

It is most uncommon for the patient to return with a recurrence of his haemorrhoids after the ligature and excision operation. Recurrence is minimized by pulling the anal canal mucosa well down before ligating. The recurrent haemorrhoid is a "secondary" haemorrhoid; the operation should be confined to the single recurrent haemorrhoid.

So uncommon is recurrence that in the event of symptoms re-appearing, the surgeon must carefully re-examine the anal canal and rectum to ensure the absence of a true rectal prolapse and to exclude the appearance of a fissure-in-ano.

(5) Impacted faeces.

The fear of defaecation might lead to faecal impaction. The patient apparently has a daily bowel action whilst in hospital; in actual fact the evacuation has been far from complete. Faecal material remaining within the rectum becomes inspissated to form a large, hard mass within the rectum; the mucosa is irritated and secretes mucus. The patient has a continual sensation of rectal fullness but straining on the closet produces only a faecal mucus.

The diagnosis is readily made; a digital examination immediately discloses the impacted faeces. It requires a general anaesthesia to remove the mass and a close watch to prevent recurrence.

Excision of one and two haemorrhoids

All three haemorrhoids are not always of the same degree; one or two may be third degree whilst the third is small and does not prolapse. The right anterior haemorrhoid is most commonly the largest, and the cause of the patient's discomfort. The surgeon can often confine the operation to removal of the third degree haemorrhoid; a large haemorrhoid should not be created out of a minimal prolapse. The convalescence after these lesser operations is smooth, and subsequent recurrence unusual.

Secondary haemorrhoids

In addition to the three main haemorrhoids, the surgeon may observe smaller secondary haemorrhoids; these are usually to be found between the primary haemorrhoids. The most common haemorrhoid of this type

is in the midline posteriorly, but they are also seen on either side of the left lateral haemorrhoid. Unless they are large they may be left alone.

If they are large, they should be removed. The one in the midline posteriorly is best removed by separate ligature. The others, which are closer to the primary pile, may be included in the main ligature for the haemorrhoid.

Internal haemorrhoids and pregnancy

Internal haemorrhoids may be troublesome during pregnancy. They do not often call for special treatment. Surgery should never be considered. Injections with 5 per cent. phenol in almond oil can be given if bleeding is persistent.

Haemorrhoids and fissure-in-ano

The presence of a fissure-in-ano prevents a full examination of the anal canal and rectum; when the surgeon comes to operate on the patient he may discover quite large haemorrhoids. The haemorrhoids should be removed, and the fissure can be left alone although any skin tags related to the fissure require excision. It is useful to divide the subcutaneous sphincter through the right posterior haemorrdoidal wound. If the haemorrhoids be small, the fissure alone is treated; it is excised and the wound skin grafted.

A CASE OF CEREBRAL ABSCESS FOLLOWING MINOR HEAD INJURY

By K. G. JAMIESON
Alfred Hospital, Melbourne

INTRA-CRANIAL infection is a not uncommon sequel of head injury, and, in the case of skull fractures compound externally or into the accessory air sinuses or middle ear, one is always on the alert to detect and to treat this serious complication. However, it is felt that this present case warrants separate report for two reasons. First, it followed a minor head injury in which no skull fracture was detected; and secondly, it well illustrates one of the possible methods by which cerebral abscess may occur.

CASE REPORT

A man, aged 59 years, was admitted to the Alfred Hospital, Melbourne, on 22nd September, 1952. The history of his illness was that twelve days previously he had suffered a blow on the right side of the forehead from a swing door, without loss of consciousness. A considerable haematoma had formed and had spread to involve the periorbital tissues on both sides, and the nasal bridge which, a witness said, was then twice its normal width. Apart from this he had felt quite well until seven days before, when a right frontal headache had commenced, and had persisted since. For two days he had been increasingly drowsy, had vomited without nausea, and his condition had been deteriorating.

On admission, he was extremely drowsy, uncooperative and photophobic, with a temperature of 102°F, pulse rate 68, and blood pressure 130/70 mm. mercury. Examination of the head revealed an old bruise, one inch in diameter, and about two inches from the midline in the region of the right frontal hairline. The skin was intact and there was no evidence that it had been broken by the injury. Surrounding the bruise was an area of inflamed and oedematous scalp, quite puffy and tender to the touch. Examination of the ear, nose, throat and paranasal sinuses revealed no evidence of infection. The optic fundi appeared normal and the pupils were equal and reacted to light. There was a slight left facial weakness, hypotonia of the left-sided limbs and the left plantar reflex was equivocal whilst the right was flexor. Minimal neck stiffness was present.

Lumbar puncture produced almost clear fluid at a pressure of over 300 mm. of cerebrospinal fluid and microscopy of a specimen revealed 200 polymorphonuclear leucocytes per c.mm. The blood white cell count was 15,000 with a considerable shift to the left in the Arneth index.

FIG. I. Portion of an antero-posterior projection of a carotid angiogram, showing the right anterior cerebral arterial system on the right of the illustration, and the right middle cerebral system on the left of the illustration. Superiorly, below the skull outline is an avascular strip, below which the cerebral surface may be seen.

Plain X-ray examination of the skull revealed no abnormality, and the accessory nasal sinuses appeared clear in these films. Right percutaneous carotid angiography was then undertaken under local anaesthesia and the findings were as follows: In the antero-posterior projection of the arteriogram (Fig. I) both anterior cerebral arteries were filled and there was no shift from the midline. There was a narrow avascular area over the vertex laterally which was thought to represent a subdural or epidural collection of fluid. In the lateral projection of the phlebogram (Fig. II) the notable feature was the non-filling of the anterior half of the superior sagittal sinus and of the frontal cortical veins, together with prominent filling of what appeared to be a collateral circulation through veins leading to the inferior sagittal sinus.

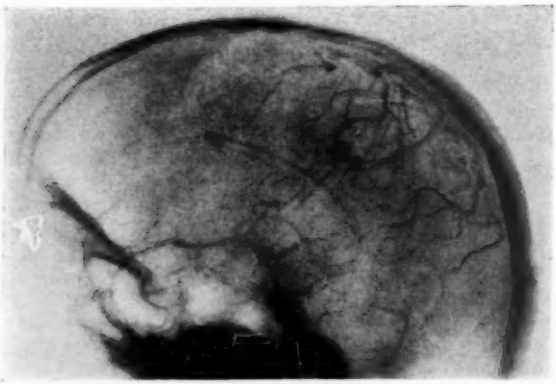

FIG. II. A right lateral projection of the cerebral phlebogram, showing good filling of veins in the parietal region, and of the posterior half of the sagittal sinus. There is no venous filling in the frontal region.

A provisional diagnosis was therefore made of sagittal thrombo-phlebitis with subdural and/or epidural abscess and Pott's Puffy Tumour.

Immediate operation was decided upon and, under general anaesthesia, a right frontal burrhole was made just medial to the area of bruising. The *galea aponeurotica* appeared rather necrotic and the bone vascularity was increased. From the depths of the bone opening there welled up about 5 ml. of thick, creamy, offensive epidural pus. The craniotomy was then extended and the *dura mater* was seen to be rather thickened and vascular and very tense. Incision into the *dura* was rewarded by the escape of a further half-an-ounce of pus from the subdural space, the area of this collection extending down toward the temporal region. A right temporal burrhole, adjudged to lie over the posterior extremity of the subdural abscess, was then made and about an ounce of clear, straw-coloured fluid escaped from the subdural space, which was then gently irrigated to remove all pus. The underlying *arachnoid mater* was seen to be thickened and somewhat opaque and many of the cortical vessels were thrombosed. As the brain did not appear to be under increased tension and in the presence of a surface pus collection, it was thought unwise to seek a cerebral abscess at this stage and the incisions were closed with drainage.

An attempt was made to identify the responsible organism, but culture of the pus in both aerobic and anaerobic media proved sterile. This was attributed to the administration, upon admission, of 300,000 units of penicillin intramuscularly and 2 gm. of soluble sulphonamide intravenously.

The next day the patient suffered left-sided Jacksonian epilepsy, but his general condition was quite good. Inspection of the wound revealed a free drainage of pus and of blood-stained fluid.

On 25th September, the patient was more deeply unconscious, with shallow, rapid respirations (50 per minute), thin pulse (130 per minute), and a temperature of 104°F. Lumbar puncture showed a pressure of 550 mm. of cerebro-spinal fluid which contained 60 polymorphonuclear leucocytes and 14 large mononuclear cells, but no organisms. The left hemiparesis persisted and the eyes were now deviated toward the left side, and a right frontal cerebral abscess was thought likely to be present.

The field of the previous operation was then re-explored and the epidural and subdural spaces were found to be clear. By aspiration through a brain needle a right frontal abscess was disclosed, and, through a small cortical incision, about 2 oz. of soft, necrotic and blood-stained white matter was evacuated with the sucker. No frank pus was encountered and the collection was not encapsulated. The walls of the resulting cavity appeared to consist of normal white matter and the cavity was drained. A left frontal burrhole disclosed similar arachnoiditis and cortical thrombosis, but no pus was encountered.

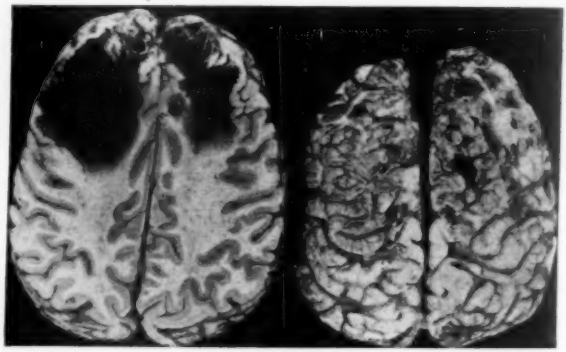

FIG. III. On the right is seen the superior surface of the brain (portion of the left hemisphere had been removed for section before photography). The arachnoid clouding, thrombosis of vessels and haemorrhage is well seen in the right frontal region, where also the site of a drain tube may be seen.

On the left is seen a horizontal section through the cerebrum, showing the appearance of infarction in both frontal lobes. The petechial haemorrhages in the remainder of the section were probably due to respiratory distress resulting in venous engorgement.

The succeeding two days witnessed deepening coma with increasingly rapid and shallow respiration and pulse rate, and despite intensive chemotherapy with penicillin and streptomycin, death occurred on 27th September.

At autopsy, the brain was removed together with a good deal of the *dura mater*. Examination of the formalin injected brain showed the frontal lobes to be very definitely abnormal. There was general clouding of the arachnoid, many of the sulci contained pus and the majority of the cortical vessels appeared to be thrombosed. The base of the brain did not show any evidence of meningitis, the large vessels appeared healthy, and there was no gross uncinate herniation. There was a moderate degree of callosal herniation, the left frontal lobe bulging into the right.

Examination of the *dura mater* showed that the anterior third of the sagittal sinus was thrombosed, as well as the veins entering in this region. The central veins and the sinus behind them were patent.

Horizontal section through the hemispheres revealed a massive haemorrhagic area in the left frontal lobe, thought to be an infarct rather than a haemorrhage because of the minimal distortion and disruption which had resulted. The brain about the cavity in the right frontal lobe was reasonably healthy in appearance, apart from scattered ecchymoses. Section through the basal ganglia, cerebellum and brain stem showed them to be healthy in appearance.

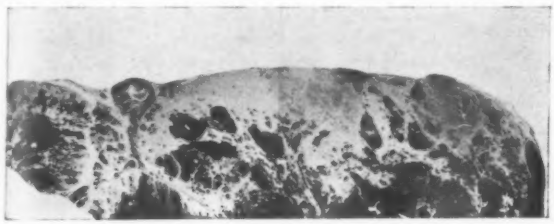

FIG. IV. Photomicrograph showing collections of subarachnoid pus in the cerebral sulci, extending down into the brain wherein are seen small haemorrhages and abscesses. (x 4)

Microscopy (Fig. IV) showed well the accumulations of pus in the cerebral sulci, and extending down the peri-vascular spaces, with underlying cerebritis and small abscesses.

Death was considered due to involvement of the basal ganglia—and especially the caudate nucleus (which may account for the hyperthermia)—in the left frontal infarction.

DISCUSSION

It has been said that were it not for the venous communications between the scalp and the dural venous sinuses, scalp wounds would lose half of their significance. In this case we have no open and infected scalp wound but, in reconstructing the course of events, we are forced to conclude that the original haematoma became infected—possibly in the region of its nasal extension—and that this infection spread to the sagittal sinus. The rest of the story is classical. Scalp infection producing Pott's Puffy Tumour, osteomyelitis (as evidenced by the increased vascularity of the bone), epidural and subdural abscess and arachnoiditis form a through and through infection of the cerebral coverings. Retrograde thrombo-phlebitis along the sagittal sinus to its tributaries, with resultant surface and deep cerebral infection completes the pathological picture of one of the modes of production of cerebral abscess.

The case also illustrates other results of sagittal thrombo-phlebitis. Hemiparesis and Jacksonian epilepsy were present as lateralizing signs and a cerebro-spinal fluid pressure of 550 mm. was found without gross space-occupying lesion or tentorial herniation. The haemorrhagic infarct found at post-mortem may also be interpreted as being the result of venous obstruction.

Unfortunately, the causal organism was not identified, so that chemotherapy was quite empirical. Nevertheless one gained the impression at post-mortem examination that the right frontal lobe was in better condition than the left and that, in the absence of meningitis, the patient might have survived the infective element of the threat to his life. Whether anything further might have been achieved by evacuation of the left frontal infarct remains a matter for speculation.

Finally, whilst the history of this case is very unusual it does exemplify the possibility that serious complications may follow trauma of no great severity. As the Hippocratic aphorism has it, "No head injury is so trivial that it can be ignored, nor so serious as to be despaired of."

SUMMARY

1. A case of post-traumatic infection of the brain and its coverings is presented.
2. The severity of the injury was slight, but its sequelae resulted in death.
3. One possible mode—retrograde thrombophlebitis — of production of cerebral abscess is illustrated.

ACKNOWLEDGEMENT

I am indebted to Mr. H. C. Trumble, Honorary Neurosurgeon at the Alfred Hospital, for permission to publish this case.

The angiography was performed by Dr. H. A. Luke, and the photography by Mr. T. O'Connor, of the Alfred Hospital. Professor E. S. J. King provided the photomicrograph.

SOME ASPECTS OF THE SURGICAL TREATMENT OF OPEN HAND INJURIES

By Stephen Barclay

Grey Hospital, Greymouth, New Zealand

"When we consider what a wonderfully perfected piece of mechanism the hand is, it is not surprising that successful reconstruction of it by surgery is unusual."

—Bunnell, *Surgery of the Hand*

In timber and coal producing areas severe hand injuries are not uncommon and from experience of such, some interesting points have emerged. These injuries often fall to the care of a general surgeon who may be far from specialist help.

Axe and knife wounds present good opportunity for precise reconstructive work; circular saw injuries, though varying in the amount of tissue destroyed, often offer surprisingly good prospects of repair. Crush injuries, blast and gunshot injuries and avulsion injuries vary widely in severity but late development of deep diffuse scar tissue often results in more impairment of function than is anticipated. A very conservative policy is normally best.

General Principles

Provided the injury is seen within about twelve hours one may elect total immediate repair. The decision depends on the nature of the injury, dirtiness of the hand and first dressing, the patient's work, age and general health. In borderline cases, bone or bone and nerve may be dealt with, and tendon repair deferred. In late cases, conservative surgical cleansing (debridement) and loose skin suture is indicated. Contamination by metal dust, coal dust, wood sap or mineral grease is not of itself important. Animal fat or meat juices seem to predispose to sepsis. Thus, wounds in trappers, butchers and others who skin animals require especial care. Cement dust tends to produce irritation and late deep scar formation. The more comprehensive and meticulous the repair work done at the primary operation the better the end result. In most, with the exception of flexor tendon injuries, all hand structures can and should be repaired when the injury is first treated.

The basic essential is a meticulously thorough gentle mechanical cleaning of the wound, removal of all foreign matter and devitalized tissues and fine trimming of all frayed, ragged edges. Irrigation with Proflavine (1/1000 Neutral) is a standard measure after preliminary cleaning with watery Cetrimide (1 per cent.). This is not intended to deal with infection, but to act as a mechanical sluice for debris, and to deal with contaminating organisms lying free in crevices or tissue interstices. It does not harm the most delicate tissue and its copious use throughout operation supplements mechanical cleaning. This is a rational use of the drug, utilizing its proven virtues but not exceeding its limitations. The local use of sulpha drugs, penicillin, or streptomycin does not seem indicated.

Antibiotics are, it appears, inferior to Proflavine as immediate contact decontaminants, but if no appreciable dead tissue is left in the wound their systemic use post-operatively is effective.

Gelatin foam, used in small pieces to quell ooze from bone ends or muscle masses such as *interossei* is occasionally a valuable haemostatic. No complications have been attributable to its use.

No. 50 cotton is preferred for most ligatures and miscellaneous sutures, Nos. 36 and 40 for tendon repairs. Stainless steel wire

(.003″ diam.) is equally good for tendon repairs. A wire of .004″ diameter doubled is used for most bone wiring with .010″ diameter for metacarpals. Catgut is never used and cotton is used for skin sutures.

Early movement is not encouraged. Removable splints are seldom used in the early stages but plaster of Paris is freely used. No splint is to be relied on, especially under out-patient conditions, for such purposes as maintaining full extension of a phalanx. Undamaged digits must be exercised early.

Very free use is made of immediate split skin grafting to cover all types of defect. I have not yet had a graft less than 80 per cent. successful. Most "take" completely on any surface. I have repeatedly put fairly thick split skin over completely bared tendons with no sheath or gliding substance left at all and watched full recovery without significant adherence of tendons to the skin which usually becomes freely mobile over them. In a small proportion some adherence has persisted. The grafts take perfectly well on fat or ligament, muscle or cut bone. I have never had any failure of take on freshly cut bone, and have several times put split skin over the intact articular cartilage of a whole metacarpal head and in every instance it has survived. This skin surface becomes mobile to a small but adequate extent on the bone or cartilage beneath, and several times such grafts, used as a temporary cover to get the wound healed, have been left permanently and withstood heavy work perfectly well. Larger grafts are tacked in place with a few fine sutures, small ones are not sutured. Thrombin is not used. Reliance is placed on covering the graft, if there is a hollow, with a shaped wad of vaseline gauze of proper thickness to obtain even pressure and bandaging this in place with vaseline gauze roll. If this is made fairly greasy, it may be smoothed against the skin with the fingertips and then adheres very well. The vaseline gauze bandage is covered with gauze wads or gamgee tissue and, if the situation permits, with a crepe bandage. If this is unsuitable, plaster of Paris may be used and will also provide splintage of digits. Grafts are dressed on the fourth or sixth day, but are left longer if immobilization is otherwise necessary. I generally use the forearm of the injured hand (flexor surface) as a donor area and prepare this by mechanical cleaning followed by Cetrimide or Proflavine.

Local flaps are rotated where it is necessary to provide a bulky cover; the donor areas are sutured or skin grafted. Free use of split skin grafts renders the use of such flaps uncommon although no difficulties have been encountered. A double pedicle flap is occasionally of use, for example, to cover an opening into a joint. If cut in the long axis of a digit it need not impair nerve supply seriously. In digits, the donor area for flaps should always be free grafted as an attempt at suture narrows the circumference of the digit and produces tight, scarred tissues or sloughing.

Free use is made of internal fixation of severed bones, usually by wiring the fragments together by fine stainless steel wire inserted through one or (preferably) two sets of fine drill holes. In children, or with very small fragments, a dental root canal drill is useful. This method alone gives good results in oblique severance of digits as by an axe. Such injuries are almost always associated with tendon division and, in my experience, only meticulously exact fixation of the bone fragments by wiring will give a perfect end result. Study of specimens removed for other reasons and X-ray and clinical observations show that such well-wired fractures are solid after three weeks with no bulging or deformity of the bone. In the case of a finger, any deformity, bulkiness, or excess of callus is likely, in the presence of tendon and soft tissue injury, to give a bad end result. Even where considerable bone is lost, as in circular saw injuries, wiring of fragments often gives a surprisingly good result because tendons and soft tissues are lost, therefore shortened, in rough proportion. Periosteal holding sutures are unreliable and seldom used, but seem adequate for some single metacarpal fractures due to saw injuries. Removable wire or pin fixation, is very rarely used and continuous traction has not been employed.

Extensor tendons are repaired by direct suture with 2 or 3 simple sutures, or a loose central mattress suture with 2 fine lateral sutures. For flexor tendons my present preference is for direct suture by the "twining vine" type of suture if primary repair is done. Splinting in moderate flexion of the finger and full flexion of the wrist is adopted. I am now seldom willing to attempt primary flexor repair in the finger. A more recent case of primary repair of *flexor profundus*, middle phalanx, digital nerves and the extensor apparatus has, however, been successful as regards the bone and flexors but a slight loss of extension may yet require further intervention.

If primary repair fails or is not done, tendon grafting has yielded the few really successful results to date. If both flexor tendons are severed in the finger proper only the profundus is sutured or grafted, the sublimis being excised. Flexor tendons are a most worrying problem. My own results are not at all spectacular but a few real successes encourage perseverance. I have occasionally replaced extensive loss of extensor tendons (as in planing machine injuries) at the primary operation by transfer of the distal end of an extensor from a finger about to be amputated, or by using the useless strip lying over the metacarpal of an absent digit as a free graft, with good results.

Primary suture is done whenever the ends of any severed nerves can be located. I have undertaken a very few free grafts for extensive digital nerve losses and, in such cases, marked the severed ends by cotton knots at the primary operation, joining the knots by a fine cotton thread, easily found later. Results have appeared good but how much was due to the graft and how much to a "taking over" by intact nerves, I do not know.

Sometimes there is loss of one end of a phalanx and part or whole of its articular area. Small losses may be ignored, but if most of the articular surface is lost the remainder should be cut back ⅛". This gives a good range of movement in some, and is most often necessary at the proximal interphalangeal joint but regrettably the results at this joint have been least satisfactory. Resection of both articular surfaces has been used but not with real success. Even small fragments bearing an articular surface may, if they have some periosteal attachment, be sutured or wired very accurately into place and yield an excellent joint function. I do not yet know how many of them will develop gross arthritic changes in a few years. Metal caps (vitallium) for raw phalangeal ends are theoretically attractive if used at the time of primary repair but I have not been able to try them out. At present I have two promising results from a nylon arthroplasty of an interphalangeal joint (Kuhns, 1950).

SOME TYPICAL PRORLEMS

Loss of part of the finger pulp

A split skin graft is sutured in place with firm dressing. This is adequate even if there is some bare bone, if a reasonable bulk of pulp is left on the palmar aspect. If the graft partly fails, these injuries heal in surprisingly well. Moving a laterally based double pedicle flap of pulp up and free grafting the proximal palmar surface of the terminal phalanx has not been satisfactory. Amputations should never be done.

Loss of the whole of the finger pulp

Immediate application of an abdominal pedicle graft (tubed or not as preferred) is satisfactory. The pedicle flap can be three times as long as the base is broad and is best cut tapering a little to its free end and widening a good deal in its basal part. Close the abdominal wall at once by undercut and suture. Concentrate on fitting the graft very accurately against the nail stump or fold and try to attach it so that at least half the palmar surface of the finger is sutured to the graft. The pedicle is tested at 14-16 days, divided if satisfactory, and the distal end sutured to the rest of the finger. The result is an ugly, bulky graft, but three months later the entire palmar scar is completely excised, the surplus fat removed, perhaps a small triangular excision of skin made at one end, and eventually a finger tip of pleasing shape attains excellent sensation. All such

patients must be warned against burns, particularly from holding cigarettes.

The only poor results I have had came from attempts to make too neat a repair when the pedicle was divided. Adequate late revision seems much better. In elderly subjects amputation for total loss of the pulp may be indicated.

Compound bony injury of the distal interphalangeal joint or base of the terminal phalanx with severance of flexor and extensor tendons

If there is any blood supply to the pulp, destroy all the remaining articular surface, leave the tendons alone and plaster in flexion aiming for ankylosis. If sensation remains in the pulp, the finger tip is useful for most classes of work. (If the flexor tendon is intact, resect one or both articular surfaces if necessary and repair the extensor as best possible.)

Axe wound of middle or proximal phalanx with oblique division of the extensor tendon and bone, flexor tendons intact

This is very suitable for meticulous bone wiring using two sets of laterally placed drill holes; then suture the extensor tendon, interposing soft tissue beneath it if possible, and plaster in full extension for three weeks. These patients do well.

Circular Saw injury

The same procedure may be used; results are often satisfactory but, if the extensor is very frayed or avulsed, a tendon and paratenon graft may be required later.

An axe wound severing bone and extensor and both flexor tendons, blood supply by 1 digital vessel, digital nerves intact or at least one found and reparable

I have experimentally repaired such injuries in one stage with good healing of bone and extensor tendon, but in only one case did the flexor repair succeed. For most working men the finger should be amputated. In those who have lost other fingers, in children, or in certain special occupations, I will continue to repair nerves, bone and extensor tendon but will leave the flexor tendon for grafting later if the finger survives and has adequate pulp sensation.

Circular saw or crush wounds of this severity seldom warrant repair, though each should be investigated at operation with this in mind. Absence of joint damage is a point in favour of repair.

Massive loss of skin and soft tissues of the dorsum of the hand or fingers with intact tendons

This indicates immediate split skin grafting. If the tendons are very grossly damaged and subsequent tendon grafting is likely, there is a choice between split skin, replaced later by a pedicle graft or an immediate abdominal pedicle graft. I would use the latter for the worst cases and put split skin on borderline cases and fingers.

Massive loss of palmar soft tissues of fingers or hand

The indication is for an abdominal pedicle graft, except in the very late or very badly crushed, where temporary split skin coverage is safer because of the risk of sepsis. I have seen very few of these massive palmar losses. It is worth some risk to place a wad of fat and skin over intact flexor tendons and digital nerves at once. If the tendons are gone there is no point in risking sepsis; deliberate planned repair by a specialist in such work is wiser and split skin will serve temporarily.

Thumb injuries

If there is any blood supply at all, repair all structures at once by any possible means, the only possible exception being *flexor pollicis longus* tendon. In one case of severance of all structures save the flexor tendon and one digital artery and nerve at the base of the proximal phalanx, including complete circular division of all skin and fat, immediate repair of all structures gave a useful thumb apart from some stiffness of the interphalangeal joint. (This was an injury by a vegetable slicer, which had to be dismantled to release the thumbs.)

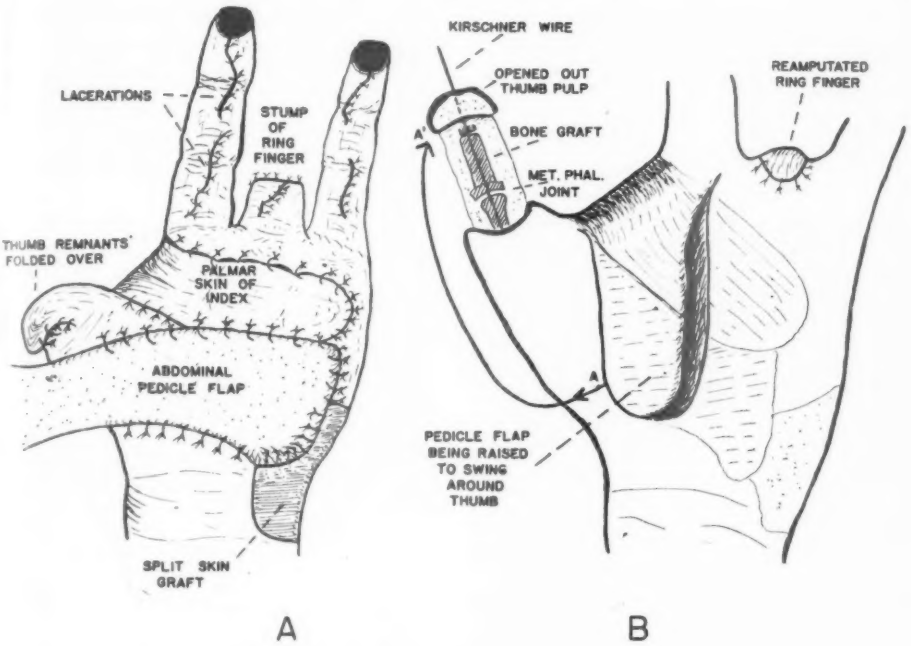

FIG. I. Case 1. (A) Shows the primary operation.
(B) Shows the steps in the reconstruction of the thumb.

Metacarpal level injuries

Proximal to the distal palmar crease primary repair of all structures is proper except in the case of burst or blast injuries. This is by wiring of fractures, suture of nerves and tendons and plastering in moderate flexion for three weeks. Some such cases require shortening of extensor tendons at a later date.

Planing machine and similar injuries

In these there is sometimes total destruction of bones and tendons of a finger leaving a long flap of viable palmar aspect soft tissues and a large loss of skin on the dorsum of the palm. In such cases the flap of finger tissues may be swung back and sutured to cover the defect. I have used this procedure and also have deliberately de-boned a useless digit, to provide a pedicle graft for dorsal defects due to injury or, in one instance, radionecrosis. Results have been excellent.

The motor branches of the median and ulnar nerves

Injury to either of these gives a severe disability. Repairs of such tiny structures should be referred to a specialist in such work unless the ends are found at the primary repair operation.

CASE HISTORIES

Case 1

A male mattress maker, aged 32, caught his right hand between heavy steel spiked rollers used for tearing up old rags, and sustained a mixed crush, stab and tearing injury with total loss of the soft tissues of the dorsum of the hand, compound comminuted fractures of thumb, index and ring fingers and extensive damage to soft tissues and extensor apparatus of all fingers. Many deep tears penetrated joints and intermetacarpal spaces.

At operation the ruins of the index finger were excised and the palmar skin flap used to cover part of the dorsal defect. The ring finger was amputated through the tip of the proximal phalanx as best possible. The lacerations of the index and little fingers were repaired. The nail and tip of the distal phalanx of the thumb were removed and the phalanx rotated upside down impacting the

tip against the remaining basal fragment of the proximal phalanx, the long flexor tendon thus running over the end of the digit and down on to the extensor surface. This was the only way in which the skin could be closed.

A large vertical abdominal pedicle flap 9" x 3" was made and sutured to the dorsal defect and a bare area over the lower end of the ulna was covered by split skin.

The pedicle was severed on the seventeenth day.

The extensor apparatus of the middle fingers was repaired three months later. Six months after injury the thumb was repaired by opening out the tissues and bone into their original positions, inserting the proximal phalanx of the ring finger as a graft, fixing it by a transfixion wire and covering the defect with a pedicle graft from the dorsum of the hand.

The pedicle was severed on the eighteenth day. One year after injury the patient had resumed his former work.

Case 2

A circular saw injury with loss of the 4th and 5th fingers and laceration of the side of the 3rd finger involving the proximal interphalangeal joint, with multiple, gouged off bone fragments and damage to extensor apparatus. The third finger area was treated by immediate split skin grafting including graft directly over the opened joint, as no soft tissues remained with which to close it. The photographs show the result three months later, when he had resumed work.

Case 3

Circular saw injury. Loss of the terminal phalanx of the thumb, the soft tissues of the radial 2/3 of the dorsum of the hand, severance and loss of substance of the extensor tendons of the thumb, second and third fingers, compound fracture of the second metacarpal with loss of ¾" of the shaft, and massive lacerations of intrinsic muscles. Repair by

FIG. II. Case 1. (A) The thumb after the primary repair.
(B) and (C) The function of the thumb one year after repair completed.

drilling and wiring of the second metacarpal, suture of extensor tendon remnants, folding back of thumb soft tissues over the dorsum, and closure of the skin defect by suture plus split skin graft to thumb plus an abdominal pedicle graft. A tidying up of the pedicle graft and further extensor tendon repair was done two months later.

When last seen, the tip of the second finger would flex to within ½" of the palm, the thumb moved well, he gripped tools strongly and could roll a cigarette.

FIG. III. Case 2. (A) The grafted area on the 3rd finger.
(B) Shows the movement at the damaged joint.

Case 4

Electrical burns of the palmar aspects of all fingers and the dorsum and ulnar aspect of the thumb over the interphalangeal joint. First seen eight days later. Attempt made to prepare for grafting. On the eighteenth day after injury the thumb joint was seen open to the surface, so two hours later the remaining sloughs were excised and a single pedicle flap from the radial aspect of the thumb was swung across the dorsum and sutured to cover the bared extensor tendon and the joint opening. The thumb donor area was grafted with split skin. The finger areas were excised and grafted at the same time. The photographs one year later show the fingers and the thumb movement.

Case 5

This young woman caught both thumbs in a large bean slicing machine. The left was virtually amputated at the level of the proximal interphalangeal joint, the skin being completely divided and the only structures holding the thumb on were the long flexor tendon and one digital pedicle of artery vein and nerve. On the right the injury was less severe but there was a compound fracture involving the metacarpo-phalangeal joint with severance of the extensor tendons—the same bone and tendon injury was, incidentally, present on the left. Immediate repair of all structures was done. The photographs show the result 4 years later.

FIG. IV. Case 4. (A) The hand after repair.
(B) The movements of the thumb.

FIG. V. Case 5. A, B, and C show the comparison of the range of movements in the affected and less affected thumbs.

SUMMARY

The field of urgent hand surgery for injury is wide and perplexing and almost every major case poses new problems. To attempt to surmount some of these requires ingenuity, patience, and meticulous care in respect of operative technique and after-management.

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THE SCOPE AND INDICATIONS FOR ABDOMINO-VAGINAL RESECTION OF THE RECTUM

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Be not the first by whom the new is tried
Nor yet the last to lay the old aside

RESECTION of the rectum for cancer was first performed towards the close of the last century, but some thirty years were to pass before Ernest Miles laid down the principles governing the selection of cases suitable for operation, and the practice which rendered the radical operation a safe and justifiable procedure. Miles laid the foundations for the modern combined abdomino-perineal resection performed by a single operator or as a simultaneous performance with two surgeons.

In 1924, Victor Bonney advocated an abdomino-vaginal method for excision of the rectum. He laid little stress on the type of cases suitable for the approach and did not point out the limitations or advantages of this method. This article lays no claim for originality in advocating such an attack but there are certain cases which lend themselves to this operation. It is necessary, however, to define clearly the indications and advantages.

The operative approach and technique have been well described and no attempt will be made here to discuss operative steps in full detail.

However, attention should be paid to the following points:—

(1) The abdominal stage is similar to the standard method.

(2) The patient should be postured as for a simultaneous combined abdomino-perineal resection.

(3) The vagina is packed with a strip of 2" gauze.

(4) When the rectum has been fully freed from above and divided, an incision is made into the posterior fornix and some of the gauze is pulled into the peritoneal cavity. The gauze is tied to the cut end of the bowel which is pulled out through the vagina.

(5) The peritoneum is now reconstituted over the pelvic floor, the colostomy made and the abdomen closed.

(6) The vagina is now split in the midline posteriorly and the final freeing of the rectum is completed. The anus may be conserved or removed according to the particular case. The vaginal wound is closed except for a small drain through the vault into the extra-peritoneal space.

The factors which must be taken into account when deciding on the vaginal route are:—

(1) Age. It is not excluded in young patients but is particularly applicable in women over sixty-five, provided the vagina is of sufficient size to allow operative manipulation.

(2) Level of growth. It should be above the levatores ani muscles but too low for an anterior resection with anastomosis. Growths at or below the levatores necessitate the removal of these muscles and a standard perineal stage should be performed (there should be two clear inches of bowel unaffected by growth above the muscle).

(3) Extent of growth. It should be limited to the rectal wall and not extend into the tissue beyond the fascia propria. To sum up, the operation is best performed if the patient is elderly with an early mobile growth at such a level than an anterior resection is not possible.

The advantages of the method are as follows:—

The abdominal stage is exactly the same as the standard procedure, and so a full assessment of the growth can be made and the second stage performed by whichever method is considered the most advisable. With the patient postured as for a simultaneous combined approach the rectum can be delivered through the vagina at the end of the abdominal stage allowing a much easier closure of the pelvic peritoneum over an empty pelvic cavity. Blood loss and shock are reduced to a minimum during the important second stage of the operation. There is no perineal wound to cause pain in the post-operative period. There is a smaller area for healing allowing earlier ambulation and minimizing the chance of sepsis. Drainage is equally dependent as in the routine perineal method.

It is a quicker procedure which may be important in a poor risk case. In old and debilitated patients, the anus and anal canal can be left *in situ* with closure of the cut end constituting a type of modified Hartman's operation. This decision can be left until the end of the first stage and if the patient will not stand a full second stage, the modified Hartman's is performed.

In conclusion, this method offers definite advantages. The only disadvantage is a less extensive removal of para-rectal tissue which should not increase the risk of recurrence if the cases are properly selected. With a small pelvis and a low growth, conservative resection with preservation of the sphincters is more easily done by this vaginal route than by the routine method from above.

ACKNOWLEDGEMENTS

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FIBROSITIS OSSIFICANS PROGRESSIVA

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FIBROSITIS ossificans progressiva is not a common condition. Few examples have been added to the literature since 1923, when Nutt found the total of authentic cases to be 130. Mair, in 1932, added several new cases in his detailed review, and in 1950, Fairbank contributed a comprehensive account of the pathology and clinical manifestations of the disease.

It is now generally recognized that the remarkable ectopic ossification occurs primarily in the connective tissue, fascia and tendons, and that, although the term "myositis" is still commonly used, the muscles are only secondarily involved. Ipponsugi, a Japanese worker quoted by Mair, published in 1927 an account of his painstaking study of the macroscopic and microscopic appearance of every muscle in the body of a subject which he examined. His findings agreed with those of other workers in emphasizing the primary involvement of the connective tissues of the body.

The Department of Pathology of the University of Melbourne possesses the skeleton of a victim of this disease, which clearly shows the bizarre arrangement of the bony plaques, which bears very little relation to the normal anatomy of the muscles. It was felt that it would be of value to add this case to those already recorded.

The skeleton is that of a young adult male, in an attitude of considerable deformity (Fig. I).

The spinal column is completely fused by ossification of its ligaments, and there is a marked kyphoscoliosis. The pelvis is so tilted that its inlet faces directly forwards.

The arms are adducted to the sides, the right shoulder joint being fixed by bony masses passing from the spines of the cervical vertebrae to the outer one-third of the clavicle, and thence to the coracoid process of the scapula and the upper shaft of the humerus (Fig. II).

FIG. I. Photograph giving a general view of the skeleton and showing the main masses of ectopic bone.

Several bony spurs project from the shaft of the right humerus, and there is a supracondylar spur on the left humerus. The bones of the forearms and hands are free from abnormal bony masses.

FIG. II. Photograph showing abnormal bone connecting the clavicle, humerus and scapula, fixing the right shoulder joint.

FIG. III. Photograph showing microdactyly in the left thumb. The other bones of the hand and wrist are normal.

The left hip is fixed in flexion by a bony bar passing from the greater trochanter to the ischial tuberosity. Spurs of bone are present just above the condyles of the left femur.

The right hip is fixed in flexion and adduction by two bony bars, one posteriorly connecting the greater trochanter and the ischial tuberosity, and a second passing anterior to the joint from the lesser trochanter to the ischio-pubic ramus.

FIG. IV. Photograph of the lumbo-dorsal region demonstrating plaques of bony tissue connecting the pelvis, vertebrae, ribs and scapulae.

Both knees are flexed beyond a right-angle. The right knee is fixed by a bony bridge passing from the supracondylar region of the femur to the upper one-third of the shaft of the tibia.

The great toes and thumbs show microdactyly, a common feature of this condition (Fig. III).

A large ramifying plaque of bone occupies the approximate site of the lumbar fascia, spreading from the sacrum and the iliac

crests to the lower ribs, and sending processes to the inferior angles of both scapulae (Fig. IV).

The ligamentum nuchae is replaced by a bony mass, from which processes pass to the inner angle of each scapula.

The skull, sternum, and bones of the lower legs and feet are free from abnormal masses of bone.

DISCUSSION

Even though clinical details of this case are not available, the skeleton is a good example of the condition and conforms closely in its general features with other specimens that have been described. There are some characteristics, exemplified by it, which deserve further mention.

The extra-muscular distribution of some of the bony masses is well demonstrated. Some of them occupy the site of muscle bellies but these pass further along fascial planes and others do not correspond at all with muscle bundles; this is well-shown in the bony plaques which cross the midline. The muscle distribution attracted attention first and the name myositis ossificans progressiva was given about the middle of the last century. It was in the early years of this century that attention was drawn to the extra-muscular distribution of the bony tissue and names such as fibro-cellulitis ossificans progressiva (Rosenstirn, 1918) and fibrositis ossificans progressiva (Greig, 1931) were suggested. Although this distribution of the heterotopic bone has been well recognized for a considerable time, attention is still often focused on the muscles. Even a cursory examination of a specimen makes the matter clear and this further example shows the extra-muscular distribution.

Although some of the bony spicules are outgrowths along fascial planes, from the skeleton, in the form of "exostoses"—along tendons, interosseous membranes, ligaments, round joints, and from the supra-orbital ridge—it is easily demonstrated that the bone is more commonly laid down in connective tissue away from the skeletal framework, that is to say, it is heterotopic bone. This frequently becomes secondarily attached to the skeleton. When muscle is involved, there is degeneration of muscle fibres and ossification in the connective tissue between or replacing the fibres.

An important feature is the occurrence of microdactyly involving the great toes (in about three-quarters of the cases) and the thumbs (in about half the cases). This may be due to diminution in size of the bones or, in some cases, to a fusion of the proximal phalanx with the metatarsal of the feet. There is diminution in size of the phalanges of the thumbs (Fig. III).

The presence of changes of this kind have led to the conclusion that the condition is "congenital" in type. There is no doubt that the association of microdactyly with diffuse ossification in so many instances should not be ignored. At the same time it is noteworthy that, though there are a few examples of the conditions being present in two or more members of a family and in twins (Vastine *et alii*, 1948), there is little evidence of familial or hereditary influences. Cases such as those in which two members of a family showed microdactyly but only one developed fibrositis ossificans progressiva deserve consideration (Sympson, 1886).

It would seem incontrovertible that there is some genetic factor active in this condition but it is also clear that, as happens with so many pathological states of this kind, environmental influences play a significant part in the development of the fibrositis. The clinical course of early days is that of some inflammatory condition of, at present, obscure character, but would appear to be strictly comparable from the aetiological point of view with other inflammatory conditions.

The elucidation of the nature of this condition will depend on results of appropriate examinations of the living individual during the development of the condition. A study of the final state provides no assistance here, but the description of the specimen with its extremely close similarity to the examples recorded indicates the well-defined character

of the disease and the remarkable correspondence of the final stages of different examples of the disease.

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The College Library

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DURING the sixteenth and early seventeenth centuries a number of anatomical works were published in which the illustrations showed the structure of the body by means of superimposed flaps. This ingenious method of illustration originated in the early incunabula dealing with astrology and cosmography and, as Crummer (1932) has pointed out, was used as early as 1485 in Johan Muller's *Calendarium*. The idea was taken up for the illustrations of the anatomical fugitive sheets of the early sixteenth century and was used by Vesalius in both the *Fabrica* and the *Epitome*. Although the earlier examples are simple with few flaps, the later examples are very complex and use numerous flaps. The flap method of securing depth in an anatomical illustration is, of course, still in use to-day, mainly in first-aid charts and books of popular medicine.

One of the most ambitious publications using this method forms the subject for this article. In 1613 there appeared an atlas of three plates accompanied by text published by Stephen Michelspacher in Augsburg and by the use of a large number of flaps the anatomy of both male and female was disclosed from the surface inwards. The short title of this work was the *Catoptron microcosmicum* and its author was Johann Remmelin, although his name does not appear on the title. Remmelin, who was born in 1583, was a physician at Ulm and worked out the initial details of the plates, which were engraved by Lucas Kilian (1579-1637), of Augsburg. McDaniel (1938) has pointed out that Remmelin's portrait and his coat of arms appear on the first plate of the 1613 issue and hence, although he is not named as the author on the title, the book was issued with his authority. The reason for saying this is that because Michelspacher's name is the only one appearing he is usually listed as the real author instead of being only the publisher. The book was at once successful and the second edition came out in 1619, this time with Remmelin named as the author. It was translated into German, Dutch and finally English and the plates were copied as late as 1754.

The following list, although probably incomplete, gives the various editions:

(a) Latin: AUGSBURG, 1613, 1619
ULM, 1639
FRANKFURT, 1660

(b) German: AUGSBURG, 1632
ULM, 1661

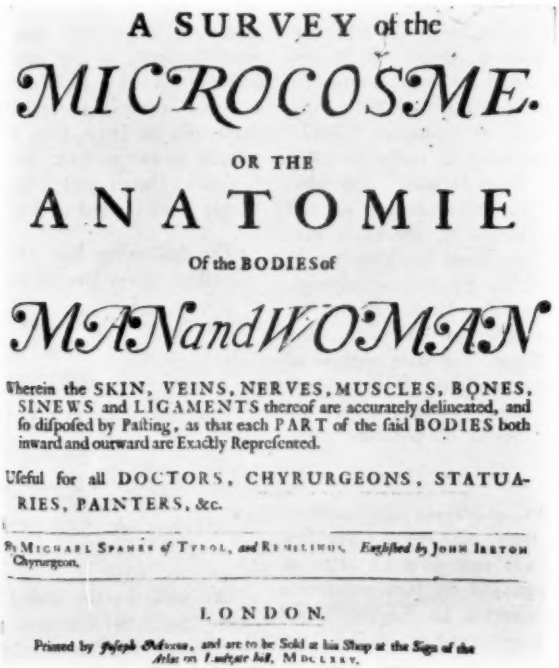
(c) Dutch: AMSTERDAM, 1634, 1667

(d) English: LONDON, 1675, 1691, 1702, 1738.

As well as the listed editions the plates were used to illustrate a work spuriously attributed to Piccolomini and published in Verona in 1754. Reversed copies of the plates were used by Christoph von Hellwig in a book published in Frankfurt and Leipzig in 1720 and again in 1744.

The College possesses, in the Cowlishaw Collection, a magnificent copy of the London, 1675, edition which is so rare as to be almost unknown to bibliographers. This edition was printed by Joseph Moxon and translated into English by John Ireton, Chyrurgeon. As will be seen in the illustration, the first plate was dedicated by

Moxon to Samuel Pepys, perhaps to give the work a more English flavour. The book itself consists of the three Remmelin plates with a short text, and has the addition of two figures of the superficial veins taken from Valverde. The addition of the Valverde figures would suggest that Moxon used the Amsterdam, 1667, issue as his model and re-engraved the plates from this edition. Because of the rarity of the 1675 London edition it is worth while giving a detailed collation of the College copy.



A SURVEY of the

MICROCOSME.

OR THE

ANATOMIE

Of the BODIES of

MAN and WOMAN

Wherein the SKIN, VEINS, NERVES, MUSCLES, BONES, SINEWS and LIGAMENTS thereof are accurately delineated, and so disposed by Pasting, as that each PART of the said BODIES both inward and outward are Exactly Represented.

Useful for all DOCTORS, CHYRURGEONS, STATUARIES, PAINTERS, &c.

By MICHAEL SPANHEMIUS of TYROL, and REMELINUS. Englished by JOHN IRETON Chyrurgeon.

LONDON.

Printed by Joseph Moxon, and are to be Sold at his Shop at the Sign of the Atlas on Ludgate hill, MDCLXXV.

FIG. I. The title page of the 1675 English edition of the *Catoptron*.

Collation:—Five unnumbered leaves made up of:—

Title, verso figures of the veins; second leaf, text on recto and verso; third leaf, recto Visio Prima, verso text; fourth leaf, recto Visio Secunda, verso text; fifth leaf, recto Visio Tertia, verso blank. Measurements of leaves, 403 x 305 mm.

The text that accompanies the plates is merely an explanation of the lettering on the figures. As will be seen from the title, Ireton makes the mistake of attributing the authorship to Michelspacher, but mentions Remmelin, as well.

Although credit must be given to the ingenuity of the printer and his skill in assembling the superimposed flaps, it must be confessed that the plates are overcrowded and the method clumsy, while the anatomy displayed lacks the detail and quality of good, simple engraving.

However, there is no doubt that Remmelin's book was popular.

FIG. II. The first of the Remmelin plates. Some of the many flaps can be seen under the arms and legs of the figures. Note, also, the dedication to Samuel Pepys.

The London editions of 1691, 1702 and 1738 bear the name of Clopton Havers (1660-1702) on the title as editor. It is not known if Havers actually did edit the issues, it is, in fact, quite possible that his name was added to the title by the publisher to attract sales, a practice not unknown at the time.

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CARCINOMA OF THE EXTRAHEPATIC BILE DUCTS

By W. B. Fleming

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Introduction

CARCINOMA of the extrahepatic bile ducts is uncommon, but it is not generally realized that it occurs more often than carcinoma of the gall-bladder. Kirshbaum and Kozoll (1941) found 62 cases in 13,330 consecutive autopsies, an incidence of 0.46 per cent. or 3.4 per cent. of all carcinomata. The subject has been given little attention in most textbooks and usually has been grouped with carcinoma of the gall-bladder. It will be shown, however, that bile duct carcinomata possess individual characters, particularly in their relation to the presence of gall-stones. This association has been well-recognized by many authors (Ewing, 1940; Willis, 1948; Kirshbaum and Kozoll, 1941; Neibling, Dockerty and Waugh, 1949) and the present study confirms this work. A high incidence of gall-stones in Australia has made it possible to study the relation in greater detail than has been recorded in previous series.

Literature

Renshaw (1922) attributes the first description of a bile duct carcinoma to McNeal in 1835. Apart from several small groups, only three large series of cases have been studied. Rolleston (1905) described 80 cases and pointed out the incidence of site of origin, age and sex, and the relation to gall-stones. In 1941, Kirshbaum and Kozoll, of Chicago, described 62 cases at autopsy. Willis reported a small series of 15 personal cases in 1942. The experience of the Mayo Clinic, over a period from 1907 until 1946, was reported in 1949 by Neibling, Dockerty and Waugh. They found and described the clinical and pathological features of 90 cases.

Material

One hundred and thirty cases have been collected from the operation and post-mortem records of four teaching hospitals in Melbourne, drawing patients from the States of Victoria and Tasmania. These cases presented during the twenty-year period from 1933 to 1952, inclusive. Adequate records and histological proof were available in 102 cases and these have been selected as the basis of this study.

Findings

Age incidence: The maximum incidence was during the sixth and seventh decades and is shown graphically in Fig. I. There was no significant difference in the age incidence in the two sexes.

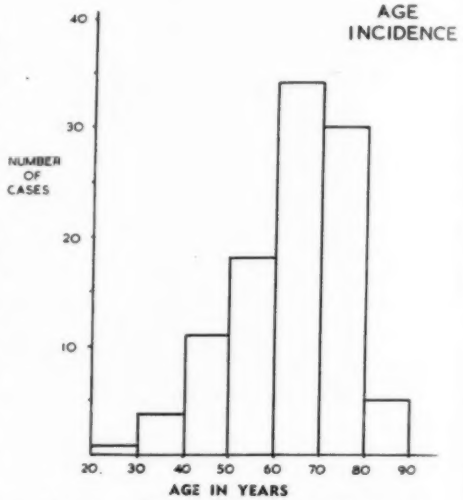

FIG. I. A graph showing the distribution of age incidence in carcinoma of the bile ducts.

Sex incidence: There were 60 males and 42 females; a ratio of 1.4 to 1 contrasts with the sex distribution in carcinoma of the gall-bladder of 1 to 4 (Willis, 1948).

Site: In some cases the localization of site of origin could only be approximate because

of the diffuse nature of the tumours compared with the small size of the parts in which they occurred. It would have been misleading, therefore, to localize all tumours to individual divisions of the biliary tree and so the classification was made according to the region of origin: for example, hepatic ducts and the junction of common hepatic duct, common bile duct and cystic duct, which was called the triple junction, *etcetera*. The number of cases occurring at each site is recorded in Table 1. The two regions most often affected were the middle and lower common duct and the triple junction and there was a distinct difference in incidence between the sexes, shown in Table 2.

TABLE 1

Showing the region of origin of carcinomas of the extrahepatic bile ducts

Site	Males	Females	Total
Common bile duct (middle and lower segment)	29	13	42
Triple junction	11	19	30
Hepatic ducts	9	5	14
Ampulla of Vater	8	4	12
Cystic duct	2	—	2
Diffuse	1	1	2
Total	60	42	102

TABLE 2

Showing sex incidence of carcinomas of the common bile duct and triple junction

Site	Proportion of males	Proportion of females
Common bile duct	One-half (29 cases)	One-third (13 cases)
Triple junction	One-fifth (11 cases)	One-half (19 cases)

Macroscopic appearances: There were three distinct patterns of growth:—

(a) In 86 cases, a diffuse infiltrating growth involving long sections of duct, in places converting it into a rigid, narrow tube resembling a "leather-bottle stomach," but usually with obliteration of the lumen and gross local extension forming a bulky, stony, hard mass (Fig. II).

(b) In 7 cases, a narrow stricture, which could be compared with a "ring" carcinoma of the colon, was found, usually in the lower common bile duct. Some of these might have represented an early stage in the development of an infiltrating carcinoma. This was the type that sometimes was mistaken at operation for a benign traumatic stricture following cholecystectomy.

(c) In 5 cases, a fleshy, fungating growth projected into the lumen of the duct with little involvement of the duct wall, or extension beyond it.

The macroscopic appearance was not described in 4 cases. Carcinoma of the gall-bladder was found as a separate entity in

4 cases and in many others the infiltration along the ducts was patchy, suggesting a multicentric origin either simultaneously or in succession, rather than an irregular spread along the duct wall.

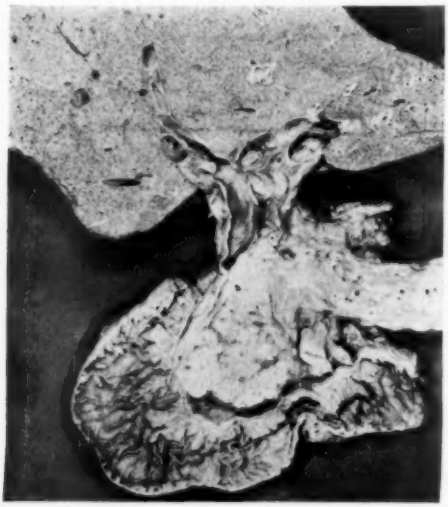

FIG. II. Photograph of a carcinoma of the common bile duct showing infiltration of a long segment of duct wall, narrowing of the lumen, and extension into the pancreas. The bile ducts are grossly dilated above the tumour.

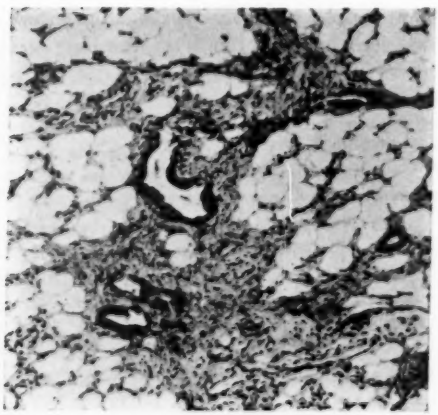

FIG. III. Photomicrograph of a secondary deposit of a columnar cell adenocarcinoma of the common bile duct in the omentum showing well-defined stromal development. (x 120)

Microscopic appearances: Two features stood out in examining sections of these carcinomata: first, the wide variation in cell type and degree of differentiation in the one tumour, and, secondly, their scirrhous nature. It was uncommon to find a medullary carcinoma of any cell type. Fig. III shows the amount of fibrous stroma in relation to a few acini in a secondary deposit of a columnar cell adenocarcinoma in the omentum.

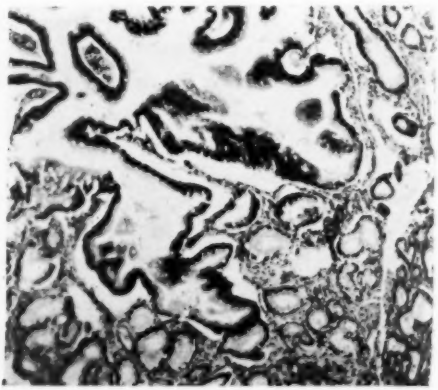

FIG. IV. Photomicrograph of a section of an adenocarcinoma of the ampulla of Vater showing the "malignant pattern" compared with the surrounding glandular hyperplasia. (x 50)

The predominant histological patterns were:—

(a) Columnar cell adenocarcinoma, sometimes with well-differentiated glandular acini producing mucus (Fig. IV) but more commonly made up of cords of cells and poorly-differentiated acini separated by masses of fibrous stroma.

(b) Papillary adenocarcinoma in which usually well-differentiated tall columnar epithelial cells covered branching connective tissue stalks (Fig. V).

(c) Small duct type where the gland-like spaces were small in diameter and lined by low cuboidal epithelium resembling ducts (Fig. VI).

(d) Spheroidal cell carcinoma with cords and sheets of spheroidal cells sometimes showing attempts at formation of acini as shown in Fig. VII.

FIG. V. Photomicrograph of a section of a papillary adenocarcinoma of the hepatic duct region. (x 50)

(e) Columnar cell carcinoma: differing from the former in that the cells were columnar in shape, often produced mucus, but separate from one another thus differing from columnar cell adenocarcinoma.

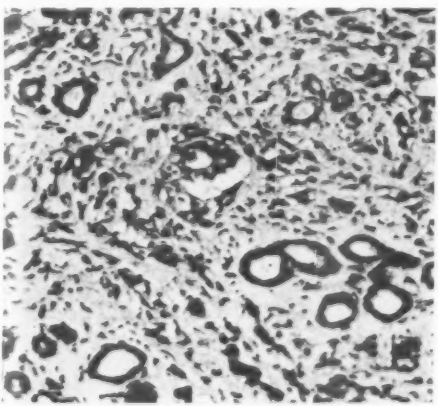

FIG. VI. Photomicrograph of a section of a small duct carcinoma of the triple junction region. (x 100)

(f) Anaplastic carcinoma. There was no constant relation between the histological pattern and macroscopic appearance, nor the site, except for carcinoma of the ampulla of Vater where papillary adenocarcinoma was found as the predominant pattern in sections of 8 out of 12 cases.

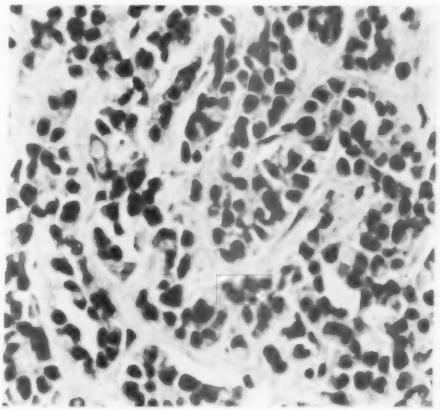

FIG. VII. Photomicrograph of a section of a spheroidal cell carcinoma of the triple junction region showing attempts at differentiation toward the formation of gland spaces. (x 350)

Spread: There were 51 cases (one-half) with lymph node metastases and/or distant metastases in other organs at the time the lesion was first seen, either at operation or at post-mortem. Lymph node metastases were present in 33 and the nodes involved were those around the head of the pancreas, those in the porta hepatis, the cystic gland and the upper pre-aortic group. Supra-clavicular nodes were involved in one patient. Blood spread to distant organs occurred in 34 cases (to liver in 25, lung in 10 and to the adrenal glands in 2).

Direct infiltration was much more difficult to assess and record. In most cases there was no minute examination made to determine the extent of direct spread, but from the nature of the growth in the majority of these tumours one would have expected considerable invasion of the liver or pancreas with carcinomata of the upper and lower regions of the biliary tract respectively. Macroscopic, direct invasion of the liver was recorded in 26 out of 44 carcinomata of the hepatic duct

and triple junction regions, but had more detailed examinations been carried out, the actual number probably would have been higher.

TABLE 3

Showing the incidence of the histological patterns of the carcinomata

Histological pattern	Number of cases
Columnar cell adenocarcinoma	58
Papillary adenocarcinoma	15
Small duct type	11
Spheroidal cell carcinoma	11
Columnar cell carcinoma	3
Anaplastic carcinoma	3
Unspecified	1
Total	102

State of the gall-bladder: The gall-bladder was distended in only 49 cases (48 per cent.) and had been removed previously in 8. The gall-bladder was not enlarged in any case of hepatic duct carcinoma and in only 9 out of 30 cases of tumour in the triple junction region. As expected, there was an enlarged gall-bladder in 28 out of 42 carcinomata of the common bile duct and in 10 of the 12 ampullary carcinomata. It is often said that Courvoisier's law does not apply in cases of obstruction of the common bile duct when prior cholelithiasis and chronic cholecystitis has left the gall-bladder incapable of distension. However, in this series, stones were present in only half of the patients in whom small gall-bladders were found in association with distal carcinomas. Six patients presented with acute inflammation of the gall-bladder, 4 of whom had carcinomata of the triple junction.

Relation to gall-stones: Gall-stones were present in 38 cases and a cholecystectomy for cholelithiasis had been performed in 8 more, making a total of 46 or nearly half. There was a remarkable difference in the sex incidence of stones associated with carcinoma of the extrahepatic bile ducts; stones being found in one-quarter of the male patients (16 cases) and in three-quarters of the female patients (30 cases).

The association of gall-stones with the site of the tumour is shown in Table 4.

The highest incidence of gall-stones was found in association with carcinoma at the triple junction. There was no significant relation between the structure nor the number of stones present and the occurrence of carcinoma.

TABLE 4

Showing incidence of gall-stones in relation to the site of the carcinoma

Site	Gall stones present Number of cases	Gall stones absent Number of cases	Proportion of cases in which stones were present
Common bile duct	13	29	One-third
Triple junction	19	11	Two-thirds
Hepatic ducts	7	7	One-half
Ampulla of Vater	4	8	One-third
Cystic duct	1	1	—
Diffuse	2	—	—
Total	46	56	

Stones were present in the common bile duct in 4 cases of carcinoma of the common duct and in 3 cases of carcinoma at the triple junction.

Clinical features: The usual clinical text-book account of the behaviour of carcinoma of the bile ducts describes the onset of a progressive, painless jaundice, often preceded by malaise and accompanied by a gross loss of weight. This history was elicited from only 38 of the 102 patients. Biliary colic occurred in 18 and pain under the right costal margin or in the epigastrium in the remainder. This pain gave rise to considerable difficulty in differential diagnosis from calculous obstruction of the common bile duct so that very few cases were suspected prior to laparotomy.

TABLE 5

Showing incidence of symptoms of onset

Symptoms of onset	Cases
Pain apart from colic	21
Obstructive jaundice	18
Malaise	14
Biliary colic	11
Nausea and vomiting	9
Loss of weight	7
Flatulent dyspepsia	7
Anorexia	4
Fever	3
Pruritis	2
Other symptoms or cases discovered fortuitously	2
Unstated	4
Total	102

Jaundice eventually appeared in all but 5 cases. Melaena occurred in 3 and occult blood was present in faeces of 11 out of 14 patients tested.

Loss of over a stone in weight was noted by 62 patients. The symptoms of onset are shown in Table 5.

Duration of illness: It was difficult to assess the time of onset of symptoms of the carcinoma as these often merged with the symptoms of gall-stones present for a considerable time beforehand. One had to find some symptom or sign which was diagnostic of the presence of carcinoma in the majority of cases and then calculate the duration of illness from the time of its appearance. Persistent jaundice was chosen as it occurred in almost all cases at some time, and in most, was the first sign to draw attention definitely to the biliary tract. Furthermore, only patients who died without operative interference could be considered in assessing the duration of illness as operation caused the death of 29 patients out of 73 within the first two weeks.

For 26 patients who died without operation, the average duration of illness from the onset of jaundice until death was nine weeks with a maximum of twenty-six weeks and a minimum of one week.

Histories from onset of the first symptom until admission to hospital were usually short, but a few long histories of flatulent dyspepsia, biliary colic, and vague malaise, probably arising from associated biliary disease, raised their average duration. If the 18 cases with symptoms for twelve months and over (averaging three years) were excluded, it was found that the time from onset to admission in the other 81 patients in whom the history was known was only nine weeks.

Surgical treatment: Of the 73 patients subjected to laparotomy, 9 had a resection of the carcinoma performed, 49 had some form of palliative surgery, and the abdomen was closed without further interference in the remaining 15.

CONCLUSIONS

Primary carcinoma of the gall-bladder is undoubtedly related to the presence of stones in the gall-bladder. The percentage of cases with gall-stones is always much higher than the percentage in the ordinary population. Siegert (1893) found stones in 95 per cent. of primary carcinoma of the gall-bladder and Willis (1942) noted stones in 24 out of 26 Australian cases at autopsy. On the other hand, stones were found in only 3 out of 26 cases of secondary carcinoma of the gall-

bladder, well within the limits of the incidence of stone in the general population (Rolleston, 1905). The reports of the general incidence of gall-stones vary, but recent Melbourne figures place the incidence at 12.8 per cent. in males and 25.5 per cent. in females. In the age groups with which this paper is mainly concerned, 55 years and over, the figures were 16 per cent. and 32 per cent. respectively (Hughes, 1953).

broken up, and for a large group of cases (common bile duct carcinoma in males) stones could have been of no significance as the incidence was the same as in the general population. However, the figures were too small to draw any firm conclusions other than to say that carcinomata of the biliary tract close to the gall-bladder were more commonly related to gall-stones than those further from the gall-bladder. The

TABLE 6

Showing the incidence of gall-stones at the common sites in the sexes compared with the general population of Melbourne over 55 years

Site	Males		Females		Total	
	Number of cases	Proportion	Number of cases	Proportion	Number of cases	Proportion
Common bile duct	4 in 29	1/7	9 in 13	2/3	13 in 42	1/3
Triple junction	5 in 11	1/2	4 in 19	3/4	19 in 30	2/3
Hepatic ducts	3 in 9	1/3	4 in 5	4/5	7 in 14	1/2
General population 55 years and over		1/6		1/3		1/4

The presence of gall-stones, similarly, has been quoted as a significant aetiological factor in carcinoma of the extrahepatic bile ducts. The overall incidence of stones with bile duct carcinoma has been given by several authors; Ewing (1940), 22 per cent.; Kirshbaum and Kozoll (1941), 30.6 per cent.; Rolleston (1905), 37 per cent.; and Neibling *et alii* (1949), 57 per cent. Gall-stones, which were assumed to be present before the carcinoma, could be considered as aetiological agents only if their percentage incidence was higher than that in the normal population. Table 6 shows the number of gall-stones present at each site in the sexes.

The incidence of stones at each site, shown in the last column of Table 6, might indicate that there was a steady decline in the aetiological significance of stones in the gall-bladder at sites further and further from the gall-bladder, the proportions being two-thirds, one-half, and one-third for carcinoma of the triple junction, hepatic ducts, and lower common duct respectively. However, the incidence in females was quite different from that in males when the totals were

association was no closer for females, except perhaps for carcinoma of the common bile duct, if one allowed for the fact that the female sex normally possesses twice the male incidence of gall-stones. The significant preponderance of females over males with carcinoma of the gall-bladder was expected, but not found with bile duct carcinoma, although triple junction carcinoma was more common in females. If gall-stones were the main aetiological agents, one would not have expected the final ratio of males to females to be 1.4 to 1, but the reverse.

The age incidence of bile duct carcinoma also differs from that of carcinoma of the gall-bladder, occurring in a slightly older age group. Illingworth (1935) quotes the age group for carcinoma of the gall-bladder as from 50 to 65 years and Willis (1948) from 57 to 63 years, while the cases of this series lay mainly between 60 and 80 years.

Diagnosis of these cases was almost impossible without laparotomy and even then quite a number was overlooked or mistaken for inflammatory stricture. Most examples were regarded as carcinoma of the head of

the pancreas. Malignancy was recognized when obstructive jaundice was preceded or accompanied by malaise, anorexia and gross loss of weight in the old age group, but probably the correct site would have been suspected more often had the search for faecal occult blood been more frequent. Occult blood was found in the stools of 11 of the 14 patients tested. Pain, which was a striking feature, has been attributed by Neibling, Dockerty and Waugh (1949) to invasion of nerves by carcinoma. They found invaded nerves in 63 per cent. of their cases and pain occurred more frequently in these.

Surgically, these tumours must always be difficult to treat. The parts are small and the common tumours occur in regions where even slight infiltration will involve important structures and make removal difficult. The nature of the tumour adds to the difficulty as most are of the diffuse infiltrating type. With the onset of such an obvious sign as jaundice which could be produced by a very small neoplasm in such a narrow duct, one would expect most of the cases to be discovered at an early stage. However, this was not so, as the early spread is along the duct wall rather than into the lumen. Most cases are too advanced for resection when first discovered, either because of local infiltration or metastases.

It is a common clinical impression that these tumours have a long life history, but the severity of their main complication, obstructive jaundice, reduces the average duration of illness to about nine weeks. Suppurative cholangitis is often already present when treatment is begun, adding to difficulties made by jaundice, wasting and old age. A mortality of nearly half within the first two weeks of operation is not unexpected. Ideal cases would be papillary carcinomata in the lower common duct or small non-infiltrating tumours at the ampulla where resections could be performed of a block of tissue containing the primary tumour and its lymph field.

SUMMARY

1. A series of 102 cases of carcinoma of the extrahepatic bile ducts is presented.
2. The pathology of the tumours is discussed, there being three main macroscopic patterns of growth and six principal histological types of tumour.
3. The incidence of gall-stones in relation to the tumours is recorded, the association being closest in those near the gall-bladder and becoming progressively less significant in more distally situated growths.
4. The clinical features of the cases are briefly presented, these being such that, in general, a correct diagnosis is not usually made.
5. A comparison is made between carcinoma of the gall-bladder and carcinoma of the extrahepatic bile ducts and some factors of aetiology are discussed.
6. Difficulties to be met in treatment are explained.

ACKNOWLEDGEMENTS

I wish to thank the medical staffs of the Royal Melbourne, Alfred, St. Vincent's, and Prince Henry's Hospitals for permission to use the records of their cases, and Mr. R. Inglis, Clinical Photographer of the Royal Melbourne Hospital, for the photograph of the macroscopic specimen.

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INADVERTENT GASTRO-ILEOSTOMY IN THE PRESENCE OF LEFT-SIDED CAECUM

By Eric M. Fisher

Sydney

ANASTOMOSIS of the stomach to the lower end of the ileum, instead of the jejunum may be carried out unintentionally during an operation, either of partial gastrectomy or gastro-jejunostomy. This, at first sight, seems impossible, as the position of the duodeno-jejunal flexure to the left of the body of the second lumbar vertebra is almost invariable.

But sometimes there is no duodeno-jejunal flexure, due to an error of rotation of the midgut; the duodenum continues down the right side of the abdomen into the jejunum, which lies in the pelvis and right lower abdomen. The caecum is unattached and, with the colon, lies on the left side while the left half of the transverse colon occupies its normal position. At operation, on searching for the flexure, a coil of small intestine may be found in the usual position of the flexure and pulled up till it appears to be fixed posteriorly, and is used as upper jejunum, when it is really lower ileum.

The ligament of Treitz is the guide and if it is not present, search should be made for the caecum.

Not many cases have been reported; Moretz (1949) collected 27 cases, 3 following partial gastrectomy and 24 simple anastomosis. The left-sided colon occurs once in 2000 X-ray examinations by meal or enema (Sear). Further, none of Moretz's cases were reported by the surgeon who performed the original operation. Therefore, it is likely that the error is made more frequently than it appears to be. Gastro-ileostomy alone is not as serious or rapid in its effect as when partial gastrectomy is done. This is obviously because, in the absence of complete pyloric or duodenal stenosis, a varying amount of stomach contents will pass through duodenum and small intestine; in the second case, only part of the stomach and lower ileum is available for digestion.

The result in either case is diarrhoea which begins soon after operation and persists: loss of weight which may be rapid and severe: vomiting and abdominal pain are variable and may be absent, but there may be eructations of foul and faecal smelling gas and even faecal vomiting. There may be bulky and foul smelling stools and undigested food may be recognized in them shortly after ingestion. Bleeding may occur from the formation of an anastomotic ulcer.

The occurrence of diarrhoea a few days after operation, which becomes persistent, and progressive loss of weight in spite of satisfactory intake, should arouse suspicion of what is wrong. X-ray investigations may show rapid filling of the colon from the stomach with very little intervening small intestine as well as a left-sided colon.

Case Report

N.M., a male, aged 61 years, was admitted to the Prince Henry Hospital on 1st December, 1950.

He had had symptoms of duodenal ulcer for twenty years. He collapsed while being given a barium enema and this was followed by melaena. A barium meal on the 19th December showed an ulcer of the first part of the duodenum. Half of the meal was in the stomach after five hours. The erythrocytes numbered 3,220,000 per cm. and the Hb. value was 64 per cent. This was raised by blood transfusion to 71 per cent. and 89 per cent. Test meal showed hyperchylorhydria with a climbing curve.

On 9th January, 1951, partial gastrectomy with ante-colic anastomosis and entero-anastomosis was done. He was discharged on 25th January.

Readmission on 3rd March. He complained of diarrhoea three or four days before discharge which had persisted. Stools varied from 4 to 15 per day and were bulky and foul. He had lost 33 lbs. weight. In hospital, diarrhoea became less but weight loss continued. Barium enema showed a left-sided colon.

Operation on 17th April. The caecum was found unattached and left-sided and the gastro-ileostomy confirmed. The anastomosis was undone, the opening in the ileum closed. The small intestine was traced up till it was obvious it continued into the duodenum high and deeply on the right side. Gastro-jejunostomy with entero-anastomosis was done.

Following operation, he developed intestinal obstruction and, on 28th April, an obstructed loop of jejunum high on the right side was freed from a pocket. He later developed a small gastric fistula which healed spontaneously.

He was discharged on 30th May. He was re-admitted twice in 1952 for cerebral thrombosis and coronary occlusion. At the present time, he is well, weight increasing but he cannot take a big meal. He has a weak and bulging operation scar controlled by a belt.

SUMMARY

A case of inadvertent gastro-ileostomy is reported.

The congenital abnormality responsible for its performance is discussed.

REFERENCES

MORETZ, W. H. (1949), *Ann. Surg.*, vol. 130, page 124.

SEAR, H. R. Personal communication.

Books Reviewed.

CARDIOSCOPY.

By WILLIAM EVANS. London: Butterworth and Co. Ltd., 1952. 9¾" x 6¾", xi plus 150 pp., 207 illustrations. Price: £2 16s. 6d.

The author has written a delightful and concise account of the radiological examination of the heart and greater blood vessels. It will prove of considerable value to those interested in the problems of surgery of the heart and great vessels. No attempt is made to discuss angio-cardiography and kymography, the scope of the book being limited to the practical information to be obtained from radiographs and heart screening.

The book provides a comprehensive description of the radiological appearance of the heart in both the normal and in disease processes, including a chapter on displacement of the heart.

The chapters on acquired disease of the heart and greater vessels are excellent although in the light of the operative findings in mitral stenosis, the radiological appearances of mitral stenosis could be elaborated further.

The chapter on congenital heart disease, with wise restraint, deals with the common lesions, and does not attempt a full description of the many rare and complicated anomalies, which often need cardiac catheterization and angio-cardiography for their elucidation.

VARICOSE VEINS.

By R. ROWDEN FOOTE. Revised Edition. London: Butterworth and Co. Ltd., 1952. 9¾" x 6¾", xviii plus 242 pp., 186 illustrations (3 plates). Price: 46s. 6d.

This entertaining book was first written in 1949. Dr. Foote, who is Honorary Surgeon-in-Charge, Varicose Vein Department, Harrow Hospital, has had considerable experience in the treatment of this condition.

As he remarks in the first edition, varicose veins are important to the individual but are also a national problem. He estimates that there are probably five million sufferers in Great Britain and it is apparent that the man-hours lost to industry and the cost in dressings, drugs and labour are great. However, anyone who has had to treat this condition and its results would not regard as necessary any apology for an adequate monograph on this subject.

This book has an interesting introductory paragraph on the historical landmarks in the treatment of varicose veins and then there are short chapters on anatomy and physiology and incidence and aetiology of varices. The main part, however, deals with the practical problems in the investigation of the patient, the various aspects of his treatment and the complications (both of the condition and its treatment) that may occur.

The approach to the problem from every aspect is essentially a practical one. Not only will the experienced surgeon find references to many points that will be of interest to him but the novice will find his problems so clearly presented that a thorough perusal of the work will be well repaid.

All methods of treatment, conservative and operative are discussed and there is, what the reviewer would regard as eminently desirable, a definite leaning towards the conservative approach.

The book can be strongly recommended to undergraduate as well as post-graduate students and, indeed, should be available in all surgical libraries.

The monograph is well printed with a clear text. Diagrams and drawings are satisfactorily produced and though some of the photographs and photomicrographs leave a little to be desired (a phenomenon common to most works dealing with the limbs) the general presentation is good. There is an adequate and carefully prepared list of references at the end of most of the chapters.

This work is recommended to all who are interested in the treatment of varicose veins and in the teaching of this subject.

TRICHLORETHYLENE ANAESTHESIA.

By GORDON OSTLERE, M.A., M.B., B.Chir., D.A. Edinburgh, Scotland: E. and S. Livingstone Ltd., 1953. 7½" x 5", vii plus 83 pp., 5 illustrations. Price: 7s. 6d. net.

Trichlorethylene owes its introduction to British Anaesthesia to the need for a non-inflammable drug which would produce strong analgesia quickly and simply for the extraction of men "burnt or wounded from inside tanks and similar confined spaces." Langton Hewer pioneered trichlorethylene anaesthesia in 1939 and its continued use in peacetime has been due in some measure to its non-inflammability in association with surgical diathermy, but it is not an easy anaesthetic to administer skilfully.

As the author states, "many administrators may have abandoned it before using it correctly and discovering its value."

This slim volume gives a fair analysis of the published work on the drug and will be invaluable to those wishing proficiency in its administration. Those less skilled than the author and his colleagues in its use may not share his enthusiasm for "trilene" but after reading his analysis will be left with few valid reasons for rejecting it without further trial.

In these 80 pages everything useful that is known concerning the drug is told concisely and lucidly—its history, general characteristics, pharmacology, its use in anaesthesia and analgesia, including observations on its safety, advantages and disadvantages.

A brief summary is given and appendices relating to physical data and tests for purity of the drug appear in the final pages.

This admirable little book has the simple, concise, and authoritative style one associates with publications emanating from those associated with the Nuffield Department of Anaesthesia at Oxford and is warmly recommended.

THE SURGERY OF PANCREATIC NEOPLASMS.

By RODNEY SMITH, M.S., F.R.C.S. Edinburgh, Scotland: E. and S. Livingstone Ltd., 1953. 10" x 7", vii plus 157 pp., 111 illustrations. Price: 35s.

This book contains the material for which the author was awarded the Jacksonian Prize for 1951 by the Council for the Royal College of Surgeons. As one would expect, there is a complete account of the anatomy, physiology and pathology of all pancreatic neoplasms both innocent and malignant with excellent microphotographs.

The diagrams are not very helpful for those about to undertake this operation. There is a description of a method of obtaining biopsy material from the small ampullary growths by the trans-duodenal route using an aspiration biopsy needle. The difficulty in diagnosing these tumours which have the best prognosis is emphasized.

The results of palliative surgery are presented and are surprisingly poor suggesting that attempts at radical excision should be continued, but insufficient cases of the latter operation are presented by the author for comparison.

The book should be studied by all interested in surgery of the pancreas.

PARKINSON'S DISEASE AND ITS SURGICAL TREATMENT.

By LESLIE C. OLIVER, F.R.C.S. London: H. K. Lewis and Co. Ltd., 1953. 8¾" x 5½", viii plus 88 pp., 12 illustrations. Price: 12s. 6d. net.

In the concluding paragraph of this volume the author states that "There is at present no cure for Parkinson's disease, but in a small proportion of patients a substantial improvement may be accomplished by surgery if great care is taken in the selection of patients. This account has been written chiefly to dispel exaggerated claims for surgery, but also at the same time to counteract prejudice, which tends to deprive some patients of relief from a most distressing malady." This statement epitomises the aims of this monograph.

The work begins with a brief outline of the clinical features of this malady and lays stress upon the absence of a consistent pathological lesion which might be considered the essential cause of the condition. Herein lies the first difficulty in evolving a rational treatment. Moreover, little is known of the neuronal circuits which are held responsible for the condition. From this point it becomes obvious that the surgeon is no better off than the physician in attempts to alleviate the distressing manifestations of the condition. Any line of attack must be first based largely upon empirical grounds and the success and failures correlated with various aspects of the clinical picture presented. It is this correlation, based upon extensive clinical experience, which leads the author to the conclusion that in a small proportion surgery has something to offer.

In addition to a discussion of the results of the procedures which the author himself has utilized, a brief survey and evaluation of other surgical methods has been included. This survey makes it clear that the proportion of patients suitable for operation is small, and furthermore, good results can only be obtained when the organization is such that a considerable experience of the disease itself may be obtained and the results of various procedures may be accurately assessed.

It is interesting to find that complete transection of the lateral column of the spinal cord on one side may finally result in no more than a slight impairment of motor power on the related side and that complete division of the spino-cerebellar tract of one side is without incident.

The monograph is a well balanced discussion of the author's clinical experience and will interest all who frequently see patients with this distressing malady.

ANATOMY OF THE AUTONOMIC NERVOUS SYSTEM.

By G. A. G. MITCHELL. Edinburgh: E. and S. Livingstone Ltd., 1953. 10" x 7", xvi plus 356 pp., 131 illustrations. Price: 55s. net.

Advances in the clinical fields of medicine and surgery frequently provide an impetus to more academic investigations. While the latter in their turn provide on the one hand a restraining influence upon the clinician, on the other hand they may provide information which is essential for continued progress in the clinical field.

In this volume Professor Mitchell has correlated a large mass of academic information in which his own findings, based upon many carefully recorded dissections, plays a prominent part.

After a comprehensive survey of the early work on the sympathetic nervous system, the author unfolds the basic arrangement of the autonomic system and the confusing issue of adrenergic and cholinergic neurones is avoided by regarding the afferent and efferent neurones at each end of the arc as terminal neurones. All other links in the arc, whether they lie within the central neuraxis or not, are termed intercalary neurones and the synapse characteristics then follow the conventional pattern. Other anatomical arrangements are treated with equal simplicity, with the possible exception of the inclusion of the first cranial nerve in the cranial autonomic or parasympathetic component.

The central connections of the autonomic system are described in detail and the importance of hypothalamic connections is given prominence, but unfortunately there is no easy simplification of what the author terms "the bewildering conglomeration of literature on the hypothalamus."

The second half of the volume is given to a full anatomical description of the peripheral pathways and here the author draws largely upon his own dissection material and the text is admirably illustrated by the anatomical drawings of Miss Davison.

The book embraces a wide field, and if the surgeon looks for defects he might find the chapters on the central connections unsatisfying and that on the blood supply redundant, while perhaps insufficient emphasis is given to clinical implications.

The author would have been well qualified to discuss the surgery of approach to the sympathetic nerves and ganglia and the rationale of operative interference. But the work remains a very complete source book of information on the sympathetic nervous system. Admirably illustrated, well set out and well written, it contains much original work of a high quality while leaving room for speculative thought.

KIELLAND'S FORCEPS.

By E. PARRY JONES, M.B., B.S., M.R.C.O.G. London: Butterworth and Co. Ltd., 1952. 8¾" x 5¾", x plus 212 pp., 25 tables, 102 figures. Price: 49s. 6d.

This monograph presents in detail an accurate description of Kielland's forceps, with the indications for their use and the methods of application. It also contains a translation of the original article on the forceps by Kielland in 1916.

The scope of the book is somewhat limited as it is definitely not to be recommended to anyone other than a specialist obstetrician who is thoroughly familiar with the usual types of forceps and with the difficulties which may be encountered in their application.

The book contains a good historical survey on forceps, the place for the use of Kielland forceps, the technique for their application, the complications which may result subsequent to the use of the forceps, and the end results both to mother and baby. All of these topics are very well presented.

The book should be read by all obstetricians during their period of training and be in the library of any obstetrician who uses Kielland forceps as he will find many points in it which will help him to better his technique.

THE AMERICAN SURGEON. Vol. XIX, No. 1.

By Dr. T. G. ORR, M.D. Maryland, U.S.A.: The Williams and Wilkins Company, 1953. 10" x 6¾", 94 pp., 24 figures.

The official publication of the Southeastern Surgical Congress of America, for years known as "The Southern Surgeon," has been changed in title to "The American Surgeon."

The first volume appeared in January, 1953, and is to be published monthly. The Editorial Board is composed of American surgeons of International repute. The index to the journal is on the first page and therefore easily located, an advantage overlooked by some journals. The first number contains twelve original articles covering a wide range of surgery. The contributions are well produced, and the illustrations are excellent. If the standard attained in this first number be maintained, the journal will find its way to all surgical libraries.

WILLIAM CHESELDEN, 1688-1752.

By SIR ZACHARY COPE, K.B., M.D., M.S., F.R.C.S. Edinburgh: E. and S. Livingstone, Ltd., 1953. 8¾" x 6¼", viii plus 112 pp., frontispiece and 24 plates. Price: 20s. stg.

It is a remarkable fact that, until now, there has never been an adequate biography of one of the most outstanding figures of British Surgery. In 1952, the bicentenary of Cheselden's death, Sir Zachary Cope delivered the Vicary Lecture before the Royal College of Surgeons and the material collected for that Lecture has been most gratifyingly brought out in book form. Cheselden was an outstanding figure in an age of remarkable men but paradoxically enough very little is known of much of his life and little or nothing survives of his correspondence or manuscript material. This has made his biographer's task a difficult one and much research into official archives has been necessary. It is a great pity that Cheselden's letters have disappeared, for his friends included many notables, among whom were Richard Mead, Jonathan Richardson, Alexander Pope, William Stukeley, James Douglas and Sir Hans Sloane. Cheselden was most famous as a lithotomist, but he was a most able anatomist and a skilled artist; the latter accomplishment being shown in the plates of his *Osteographia* and his *Anatomy*.

His biographer has cast his net widely and has gathered a number of new facts on Cheselden's life and work. One of the most important features of the book is the portion dealing with the separation of the Barbers from the Surgeons and the formation of the Company of Surgeons in both of which Cheselden was greatly interested.

Sir Zachary Cope is to be congratulated upon an admirable book which must take its place among the definitive biographies in medicine. The publishers, too, deserve our thanks for this excellent addition to their historical series.

COMPRESSION ARTHRODESIS.

By JOHN CHARNLEY, F.R.C.S. Edinburgh: E. and S. Livingstone Ltd., 1953. 9¾" x 6¾", xi plus 264 pp., 208 illustrations. Price: 42s. net.

Any surgeon who has used compression of raw bone surfaces to one another, whether for arthrodesis for cancellous bone or for causing bone union in ununited fractures, would be obliged to admit that "it works." And it does this in a way that could not be expected by orthodox methods, but the explanation is not as yet wholly revealed.

The author has confined his experiences to arthrodesis of joints, and has developed his theme in a complete and combatative book that is well written and produced. The account of his observations are vivid and interesting. His arguments at times are a little hard to follow, but he has given a great deal of thought to this subject and, as a result, this book is an essential one to the orthopaedic surgeon.

Whether his operation for central dislocation of the hip as a principle in hip surgery will be established, remains to be seen.

Books Received.

THE NATIONAL HEALTH SERVICE.

Edited by MAX SORSBY, L.M.S.S.A. Edinburgh, Scotland: E. and S. Livingstone Ltd., 1953. 8¾" x 5½", xii plus 267 pp. Price: 12s. 6d. net.

DISEASE AND ITS CONQUEST.

By G. T. HOLLIS, Hon. M.A.(Oxon.). England: Oxford University Press, 1953. 7¼" x 4¾", viii plus 163 pp. Price: 15s. 9d.